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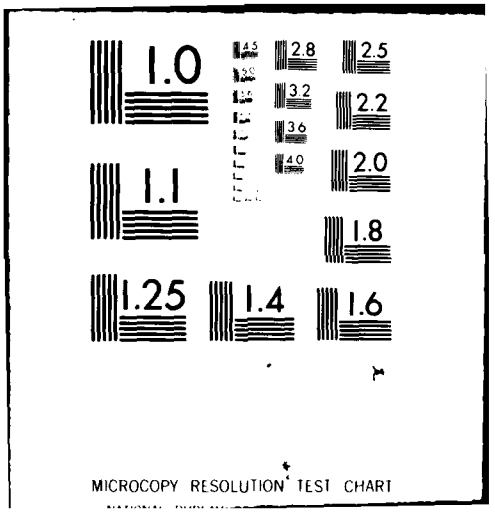
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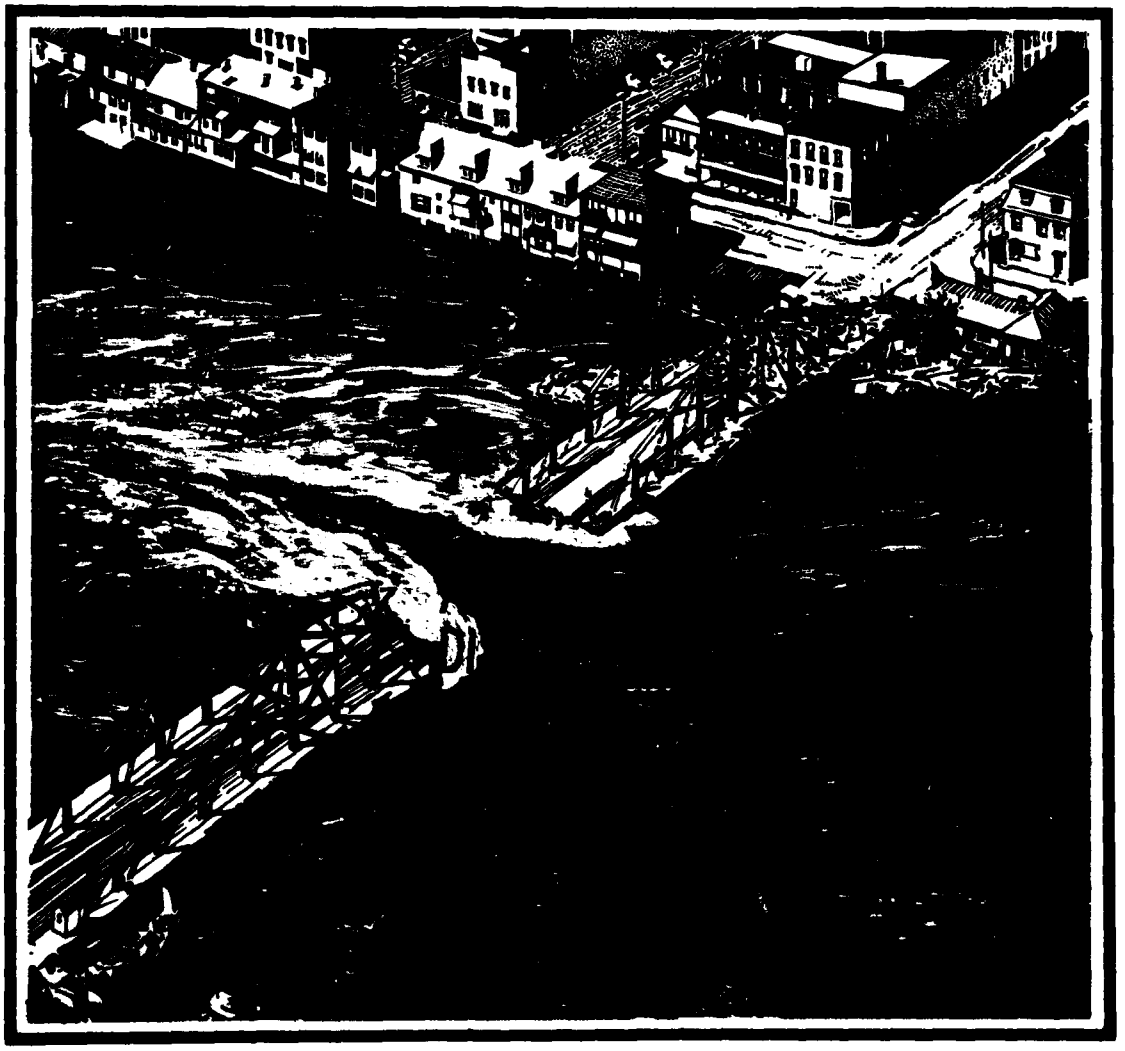
FLOOD PLAIN INFORMATIONS

BUSHKILL CREEK
VICINITY OF EASTON, PENNSYLVANIA



PREPARED FOR THE LEHIGH-NORTHAMPTON COUNTY JOINT PLANNING COMMISSION BY THE DEPT. OF THE ARMY, PHILADELPHIA DISTRICT, CORPS OF ENGINEERS, PHILADELPHIA, PA.

JANUARY 1972

REPT. NO: DAEN|NAP-82040|FPI 10-72|01

TO THE REQUESTOR:

This Flood Plain Information (FPI) Report was prepared by the Philadelphia District office of the U.S. Army Corps of Engineers, under the continuing authority of the 1960 Flood Control Act, as amended. The report contains valuable background information, discussion of flood characteristics and historical flood data for the study area. The report also presents through tables, profiles, maps and text, the results of engineering studies to determine the possible magnitude and extent of future floods, because knowledge of flood potential and flood hazards is important in land use planning and for management decisions concerning floodplain utilization. These projections of possible flood events and their frequency of occurrence were based on conditions in the study area at the time the report was prepared.

Since the publication of this FPI Report, other engineering studies or reports may have been published for the area. Among these are Flood Insurance Studies prepared by the Federal Insurance Administration of the Federal Emergency Management Agency, Flood Insurance Studies generally provide different types of flood hazard data (including information pertinent to setting flood insurance rates) and different types of floodplain mapping for regulatory purposes and in some cases provide updated technical data based on recent flood events or changes in the study area that may have occurred since the publication of this report.

It is strongly suggested that, where available, Flood Insurance Studies and other sources of flood hazard data be sought out for the additional, and, in some cases, updated flood plain information which they might provide. Should you have any questions concerning the preparation of, or data contained in this FPI Report, please contact:

U.S. Army Corps of Engineers
Philadelphia District
Custom House, 2nd and Chestnut Streets
Philadelphia, PA 19106

ATTN: Flood Plain Mgt. Services Branch, NAPEN-M

Telephone number: (215) 597-4807

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Easton, Pa.
Floods
Flood forecasting
Flood plains
Delaware River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

In Northampton County Pa., the City of Easton and other communities are subject to flooding by Bushkill Creek and the Delaware River. Commercial and residential properties on the flood plain of Bushkill Creek were severly damaged by a flash flood on July 9, 1945. The area in the City of Easton near the confluence of Bushkill Creek and the Delaware River suffered severe damage from the flood of August 1955.

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This report included a history of flooding in the Bushkill Creek-Easton Pa. area and identified those areas which may be subject to possible future floods. Special emphasis was given to these possible future flood forecasts thru maps, photographs and profiles. While this report doesn't provide solutions it can aid in the identification of flood damage reduction techniques.

Under authority of Section 206 of the 1960 Flood Control Act as amended the flood plain information was prepared by the U.S. Army Corps of Engineers Philadelphia District at the request of the Lehigh-Northampton County Joint Planning Commission. The information should be considered for its historical nature. Since the publication of this FPI report other Flood Insurance studies have been undertaken and should also be consulted for more current information.

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CONTENTS

CONTENTS (Continued)

TABLES

CONTENTS (Continued)

PLATES

FIGURES

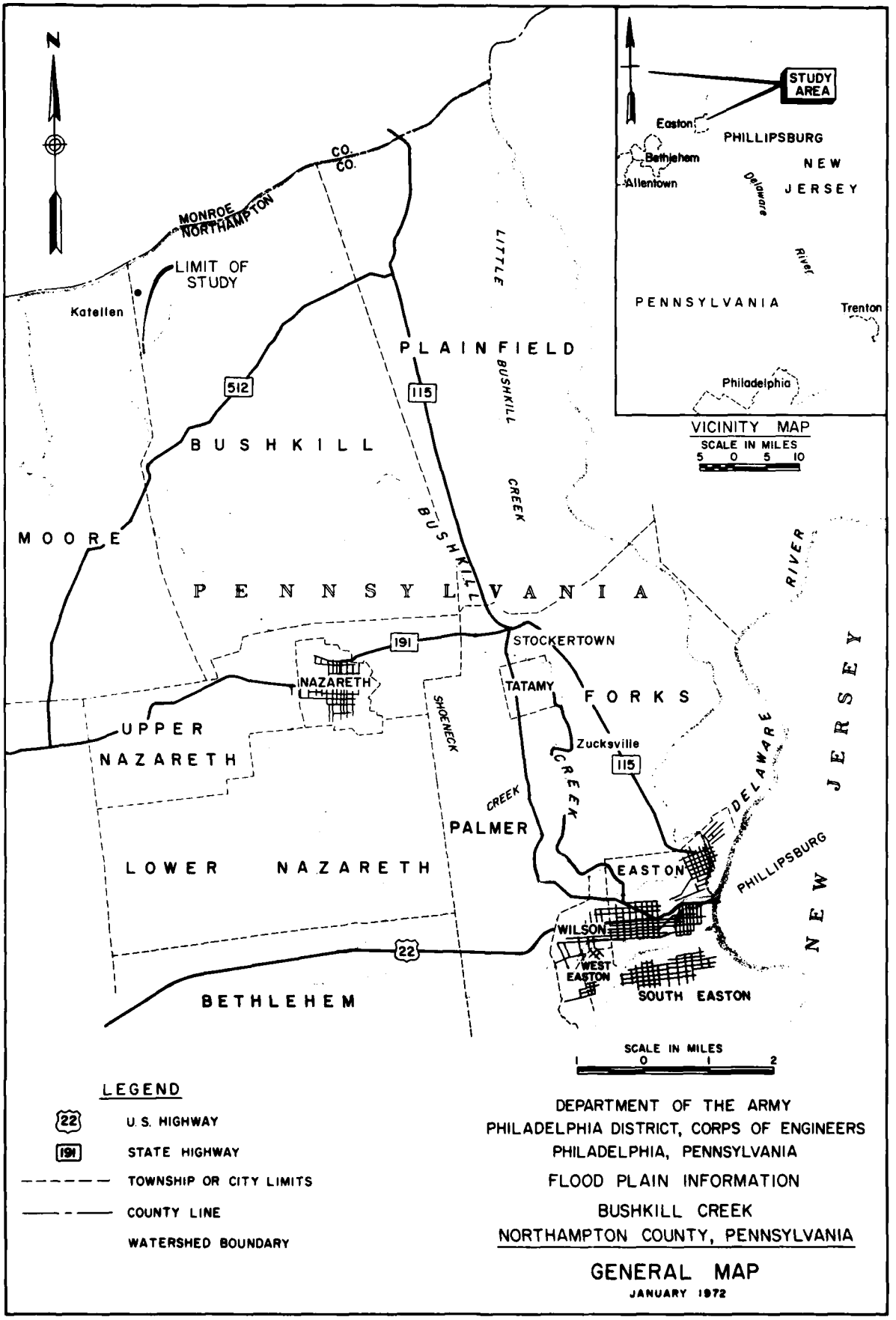

N
MONROE CO.
NORTHAMPTON CO.
LIMIT OF STUDY
Kutztown
LITTLE
BUSHKILL
CREEK
PLAINFIELD
512
115
BUSHKILL
MOORE
PENNSYLVANIA
BUSHKILL CREEK
191
STOCKERTOWN
NAZARETH
TATAMY
FORKS
SHOENECK
CREEK
UPPER NAZARETH
Zucksville
115
DELAWARE RIVER
NEW JERSEY
PALMER
LOWER NAZARETH
EASTON
PHILLIPSBURG
WILSON
WEST EASTON
SOUTH EASTON
22
BETHLEHEM
SCALE IN MILES
0 1 2
STUDY AREA
Easton
PHILLIPSBURG
NEW JERSEY
Bethlehem
Allentown
Delaware River
PENNSYLVANIA
Trenton
Philadelphia
VICINITY MAP
SCALE IN MILES
5 0 5 10
LEGEND
22 U.S. HIGHWAY
191 STATE HIGHWAY
TOWNSHIP OR CITY LIMITS
COUNTY LINE
WATERSHED BOUNDARY
DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA
FLOOD PLAIN INFORMATION
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA
GENERAL MAP
JANUARY 1972

PLATE 1

PREFACE

In Northampton County, the City of Easton and other communities are subject to flooding by Bushkill Creek and Delaware River. Commercial and residential properties on the flood plain of Bushkill Creek were severely damaged by a flash flood on July 9, 1945. Also, the area in the City of Easton near the confluence of Bushkill Creek and Delaware River suffered severe damage from the flood of August 1955. Above the City of Easton, there is an extensive area on the Bushkill's flood plain that may come under pressure for development. Although large floods have occurred in the past, studies indicate that even larger floods could occur in the future.

This report has been prepared because a knowledge of flood potential and flood hazards is important in land use planning and for management decisions concerning flood plain utilization. It includes a history of flooding along Bushkill Creek and identifies those areas that are subject to possible future floods. Special emphasis is given to these possible future floods through maps, photographs, profiles, and cross sections. The report does not provide solutions to flood problems; however, it does furnish a suitable basis for the adoption of land use controls to guide flood plain development and thereby prevent intensification of the loss problems. It will also aid in the identification of other flood damage reduction techniques such as works to modify flooding and adjustments including flood proofing which might be embodied in an overall flood plain management (FPM) program. Other FPM program studies -- those of environmental attributes and the current and future land use role of the flood plain as part of its surroundings -- would also profit from this information.

Under the continuing authority provided in Section 206 of the 1960 Flood Control Act as amended, this report was prepared in response to the request of the Lehigh-Northampton Counties Joint Planning Commission through the Pennsylvania Department of Environmental Resources. The Planning Commission will make information available to all interested agencies and individuals. Upon further request, the Corps of Engineers, Philadelphia District Office, will provide technical assistance to planning agencies in the interpretation and use of the data presented as well as planning guidance and further assistance, including the development of additional technical information.

BACKGROUND INFORMATION

Settlement

The area embraced by Northampton County was first settled by the three different tribes of the Lenape or Delaware Indians. Northampton County was opened up to the settlers by the notoriously famous Walking Purchase of 1737 wherein William Penn purchased a large tract of land in Pennsylvania from the Indians.

Small settlements appeared along streams and rivers because travelling by the existing waterways was much easier than going through the dense wilderness. An abundance of natural resources such as iron ore, anthracite coal, limestone and zinc provided the economic thrust for development. The opening of the Delaware and Lehigh Canals provided a close link between Northampton County and the large metropolitan areas on the eastern seaboard. Transportation facilities and proximity to the large cities have given the county a distinct industrial advantage.

Around the turn of the century, Bushkill Creek was used as a source of power for industries developing along the flood plain. Some of these original industries are still located on the flood plain. With the ever-increasing expansion of this part of the Lehigh Valley, many of these industries are undertaking new building programs. New Industries may build upon the flood plain because of available land and existing highway and rail networks. With the attraction of industries and jobs, people are moving from the urbanized areas to aesthetically pleasing sites along the banks of Bushkill Creek.

The Stream and Its Valley

The headwaters of Bushkill Creek originate near the small community of Katellen, Pennsylvania, on the Northampton-Monroe County Line. The stream meanders its way 21.4 miles southeastwardly to its confluence with Delaware River at Easton, Pennsylvania. A watershed area of 79.6 square miles encompasses Bushkill Creek. The upper reach of the stream, near the origin, receives runoff from the wooded slopes of Blue Mountain, part of the Appalachian chain. However, most of the runoff comes from the rolling grasslands, cultivated areas, and small wood lots of the surrounding agricultural areas. Near Easton, Pennsylvania, the creek flows through more rugged terrain, picking up the runoff from industrial, commercial, and residential areas. The upper and middle reach of the Bushkill is characterized by low banks with adjacent land sloping gently to them. In this area, the stream slopes at an average rate of 28 feet per mile. On the lower reach near Easton, the

stream characteristics vary greatly. The Bushkill is confined by steep banks, man-made fills, and retaining walls. Sharp breaks in alignment and rock outcrops on the stream bed are prevalent in this area. The stream slope is less on the lower reach, averaging 21 feet per mile. Throughout its length, the Bushkill has brush and trees overgrowing the streambed.

The climate is characterized by moderately warm summers, with temperatures occasionally rising above 85 degrees, and cool winters, with temperatures dropping below 20 degrees. The annual precipitation over the watershed averages 45 inches including runoff from 30 inches of snowfall.

Drainage areas for the Bushkill Creek watershed are shown in Table 1.

TABLE 1
DRAINAGE AREAS
BUSHKILL CREEK

Location	Mileage Above Mouth	Drainage Area (a)	
		Tributary	Total
		sq. mi.	
Junction with Little Bushkill Creek	8.2	17.5	48.7
Junction with Shoeneck Creek	5.8	13.8	65.9
Junction with Unnamed Tributary	4.0	1.5	73.5
Confluence with Delaware River	0.0	---	79.6

(a) Drainage areas include tributary drainage.

Developments in the Flood Plain

Most of the flood plain within the 21.5 mile study reach of Bushkill Creek is undeveloped land. Some areas are used for pasture or farming, and there are widely scattered residential and commercial structures.

Proceeding downstream, the first major development of the flood plain is a cement plant and numerous railroad sidings in the Borough of Stockertown. Further downstream, in the Borough of Tatamy, development includes several production and storage facilities and the local fire department. Below Tatamy, development again consists of scattered residential and commercial structures, an amusement park, and several industrial facilities.

As Bushkill Creek enters the City of Easton, its flood plain becomes more intensely developed with numerous commercial and industrial firms. Two buildings bridge the creek just upstream of its confluence with Delaware River. Throughout its length, nine dams stretch across Bushkill Creek. They are low-flow type, having limited storage capacity and no significant effect on floodflows.

Railroads, highways, bridges, and utilities that are located on the flood plain of Bushkill Creek may also be subject to flooding. Further development of the flood plain can be expected to occur in the rural and suburban areas as well as increased growth and redevelopment in the City of Easton.

FLOOD SITUATION

Data Sources and Records

There are no stream gaging stations on Bushkill Creek. The United States Geological Survey does maintain a stream gaging station on the Delaware River at the Northampton Street bridge in Easton, which is 0.3 mile downstream from the confluence of Bushkill Creek and Delaware River. Since flood stages on Delaware River have a tremendous effect on the lower reaches of Bushkill Creek, which includes the highly developed City of Easton, gage information available for Delaware River is included in this report.

To compile information on past flood occurrences and stages in the study area, it was necessary to search historical documents, newspapers and records; also, residents were interviewed for their personal knowledge and experience of past floods.

Rainfall records for particular floods in this area are very limited, due to relatively recent establishment of gaging stations compared to the long flood history. The closest precipitation gage is at the National Weather Service Station located at Phillipsburg, New Jersey, across the Delaware River from Easton, Pennsylvania. Rainfall occurrences and measurements from this station are found in Table 2.

TABLE 2
PRECIPITATION AT PHILLIPSBURG, NEW JERSEY

Occurrence	Amount of Precipitation inches	Time Period
December 1901	7.22	1 Month
March 1902	3.37	1 Month
October 9 - 10, 1903	7.21	12 Hours
July 10, 1945	6.20	3 Hours
August 11 - 14, 1955	7.24	4 Days
August 18 - 19, 1955	6.01	2 Days

Maps prepared for this report were based on U.S. Geological Survey quadrangle sheets entitled "Nazareth, Pennsylvania", 1964; "Easton, New Jersey-Pennsylvania", 1956, and, "Wind Gap, Pennsylvania", 1960. Structural data on bridges and culverts were obtained by field surveys performed by Corps of Engineers, Philadelphia District, personnel.

Flood Season and Flood Characteristics

Floods have occurred in the study reaches of Bushkill Creek during all seasons of the year with the main flood seasons being the spring and fall. Significant snowfall runoff and heavy rains cause the spring floods. The fall floods are usually caused by runoff from general rainfall over the Bushkill Creek basin on ground that has been previously saturated. General rainfall floods are typified by moderate peaks, low velocities, long flood periods and moderate volumes of runoff. Local thunderstorms on all or part of the drainage basin have produced some damaging flash floods. Floodflows from thunderstorms are characterized by high peaks, high velocities, short duration, and relatively small volume of runoff. The greatest flood of record was caused by severe thunderstorms with torrential rains over the drainage basin.

Flood stages on Delaware River will cause a backwater effect at the mouth of Bushkill Creek. However, general rainfall over the Bushkill's drainage basin combined with a backwater condition will produce higher flood stages than normally expected on the lower reach of the Bushkill. On numerous occasions, severe flooding and damage have occurred in the City of Easton due to this combination of conditions.

Factors Affecting Flooding and Its Impact

Obstructions to floodflows - Natural obstructions which could impede floodflows in floodway areas include rocks, outcroppings, trees, brush, and other vegetation growing along the stream banks. Man-made encroachments such as bridges, dams, culverts, dikes, and pipe line crossings can also restrict flows and create more extensive flooding than would otherwise occur. Photographs representative of the obstructions to floodflows are shown in Figures 1 and 2.

During floods, trees and other debris may be broken loose and carried downstream to collect on bridges and other obstructions to flow. The accumulation of debris greatly reduces the already limited capacity of obstructive bridges and culverts, resulting in increased flooding upstream. As floodflows increase, masses of debris may be dislodged to surge downstream until another obstruction is encountered. The accumulation of debris against a bridge may impose loads exceeding its structural capacity and cause it to fail. In addition, erosion of culvert entrances and bridge approach embankments can occur with possible damage to the overlying roadbed.

In general, obstructions intensify the flooding situation by causing overbank flows, with possible damage to or destruction of bridges and culverts, flooding in unpredictable areas, and increasing velocities of flow immediately downstream. Because the extent or location of the accumulation of debris is impossible to predict, it was necessary to assume, for the purposes of this report, that no debris would accumulate to clog any of the bridges or culvert openings.

The nine dams located on Bushkill Creek have no flood control capacities and they will not significantly alter the flow of floodwaters.

Bushkill Creek is spanned by 45 bridges, 2 suspended pipe lines, 1 sluicebox, and 2 buildings. Many of these structures are obstructive to floodflows. Illustrative photographs are shown in Figures 3 and 4. Pertinent information on those bridges and other structures which are obstructive to floodflows can be found in Table 6 on Page 18.

Flood damage reduction measures - There are no existing or authorized flood control projects on Bushkill Creek nor are there any city or county zoning ordinances, building codes, or other regulatory measures specifically for the reduction of flood damages. The City of Easton has become eligible for Flood Insurance under the emergency program provided by the Federal Insurance Administration of the Department of Housing and Urban Development. To continue eligibility, the City will be required to pass zoning ordinances and building codes which will affect all future construction in the flood plain. These regulations will limit the potential damage caused by flooding.

Other factors and their impacts - Flood damages can be reduced by effective flood warning and forecasting and by implementing flood fighting and evacuation plans.

Flood warning and forcasting - The National Weather Service Branch of the National Oceanic and Atmospheric Administration (NOAA) maintains year-round surveillance of weather conditions at Easton, Pennsylvania. Emergency bulletins on anticipated severe weather conditions and possible flooding are issued at regular intervals by the National Weather Service to city officials, radio stations, television stations, and the local press media for further dissemination to residents of the area. Some industries along Bushkill Creek maintain their own private stream gages in order to initiate flood damage reduction measures at the proper time. When flood stages are forecasted for Bushkill Creek and/or Delaware River, local and Civil Defense officials make observations of the river stages at various locations.

Flood fighting and emergency evacuation plans - Although there are no formal flood fighting or emergency evacuation plans for the Northampton County area, provisions for alerting area residents and coordinating operations of city and county public service agencies in time of emergency are accomplished through the Northampton County Civil Defense Office. This office maintains communication with State Civil Defense Headquarters and the National Weather Service at its control center. During earliest stages of a flood threat, they establish a flood watch along Bushkill Creek and Delaware River.

FIGURE 1 - Accumulated debris on Bushkill Creek

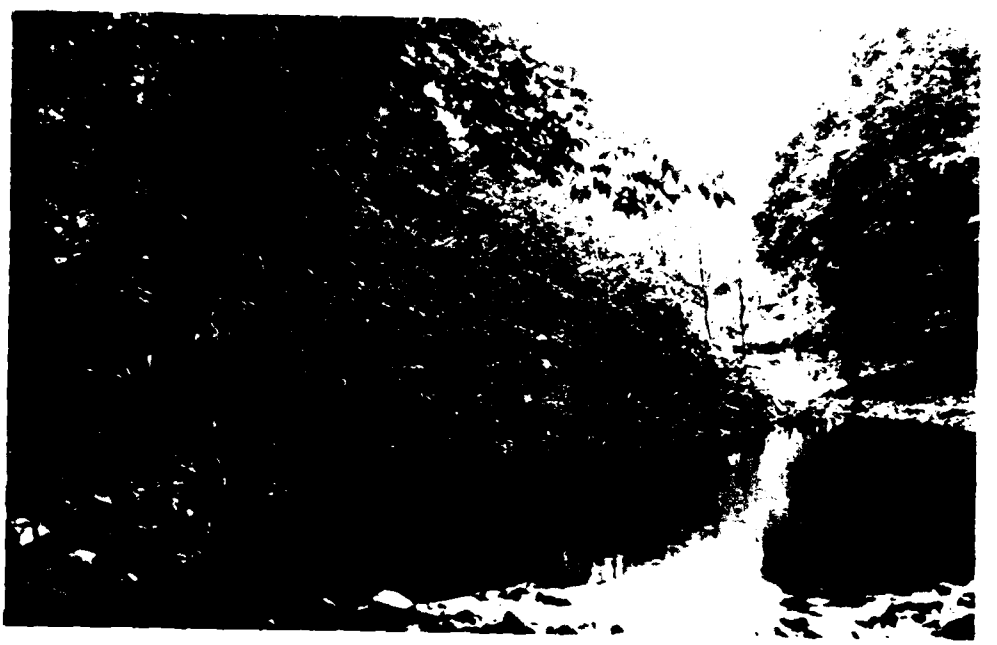


FIGURE 2 - Fallen tree across Bushkill Creek

FIGURE 3 - A building that spans Bushkill Creek, upstream from 3rd Street bridge.

FIGURE 4 - A pipeline crossing on Bushkill Creek at Mile 1.21.

PAST FLOODS

Summary of Historical Floods

Bushkill Creek has a recorded flood history dating back to 1777. The most severe floods of record occurred on the following dates: January 8, 1841; June 5, 1862; October 3, 1869; December 16, 1901; March 2, 1902; October 10-11, 1903; March 12, 1936; July 9, 1945; and, August 19, 1955.

The largest flood of record occurred on Bushkill Creek on July 9, 1945. The second largest flood of record, which affected the lower reach of the Bushkill, occurred on August 19, 1955. The third largest flood of record also occurred on the lower reach of Bushkill Creek on October 10-11, 1903, but the flood stage was five feet below that of the August 19, 1955, flood.

Flood Records

Information on historical floods in the Easton area was obtained from the stream gaging station maintained by the U.S.G.S. at the Northampton Street bridge across Delaware River in Easton. There are no streamflow records for Bushkill Creek. High water marks were obtained, residents along the stream were interviewed, and newspaper files and historical documents were searched for information concerning past floods.

Additional information used in the report concerning floods in the Easton area due to flooding of Delaware River was obtained from the publication of the U.S.G.S. entitled "Floods at Easton, Pennsylvania -- Phillipsburg, New Jersey", Hydrologic Investigations Atlas HA-246, dated 1967.

The official U.S.G.S. gage at the Northampton Street bridge in Easton was initiated in 1902. However, sufficiently reliable information on flood elevations prior to 1902 at the present gage site is available and is included in Table 3.

TABLE 3

FLOOD CREST ELEVATIONS

Delaware River at Northampton Street Bridge (a)

Date of Crest	Water Surface (b) Elevation
October 27, 1777	187.6
May 9, 1781	185.4
February 19, 1783	184.4
March 17, 1785	187.4
October 4, 1786	185.4
April 1, 1814	184.4
January 8, 1841	184.3
October 13, 1845	178.4
March 16, 1846	179.8
June 5, 1862	184.3
October 15, 1869	180.3
April 9, 1875	179.3
December 11, 1878	183.8
April 9, 1895	179.3
December 15-16, 1901	186.9
March 2, 1902	185.3
October 10-11, 1903	193.5
March 11, 1936	187.8
March 19, 1936	188.2
April 1, 1940	181.4
May 24, 1942	183.2
December 12, 1952	180.8
August 19, 1955	199.1

(a) USGS Gage No. 4470, Northampton Street bridge, Easton, Pa.

(b) Feet, mean sea level datum. Due to changes in the datum of the gage from 1777 to 1903, all stage measurements have been converted to actual water surface elevations.

Flood Descriptions

3 October 1869 - Information based on newspaper accounts that are on file in the Easton Public Library indicate that a general rainfall over Bushkill Creek, Lehigh and Delaware River basins created flooding conditions throughout the general area.

EXCERPTS FROM THE EASTON SENTINEL, 7 OCTOBER 1869, (a) RELATIVE TO THE FLOOD OF 3 OCTOBER 1869

A Heavy Rainstorm
Great Flood in All Our Rivers
Immense Destruction of Property
Railroads Damaged and Canals Washed Away

Rain commenced falling here about midnight Saturday night last, and continued, without intermission, until about seven o'clock on Monday morning. The Delaware Lehigh, Bushkill and other smaller streams in this vicinity, commenced rising during Sunday night, and by noon on Monday they presented more the appearance of rushing, roaring, seething cataracts than quiet, modest rivers and rivulets.

The Bushkill was perfectly furious during Sunday night and Monday morning and made a clean sweep of everything along its banks, causing a greater destruction of property than it has done at any one time since what is remembered as the "hog freshet" which occurred more than thirty years ago, and was called the hog freshet from the vast number of hogs that were carried away from the numerous distilleries that then lined its banks.

EXCERPT FROM THE EASTON WEEKLY ARGUS, 7 OCTOBER 1869, (a) RELATIVE TO THE FLOOD OF 3 OCTOBER 1869

Freshet in the Bushkill - This stream was never known to be so high even by the "Oldest Inhabitant". The Cemetery bridge was swept away during the night and the arch bridge near Butz's Mills is choked up with lumber and driftwood and in great danger of being carried away. Mr. Uhler lost three valuable rafts washed out of the mouth of the stream into the Delaware. The lowlands along the stream are under water and the pumpkins are taking a trip by water in great profusion.

9 July 1945 - The most severe flood in the history of Bushkill Creek occurred on 9 July 1945. Severe summer thunderstorms accompanied by torrential rainfall caused much property damage, loss of life, building destruction, and interruption of utility services. The magnitude of this flood was somewhere between the Intermediate Regional Flood and the Standard Project Flood. The following newspaper excerpts provide a graphic description of this flood:

(a) Simulated from newspaper clippings

EXCERPTS FROM THE EASTON EXPRESS, 10 JULY 1945, (a) RELATIVE TO THE FLOOD OF 9 JULY 1945

The rainfall in the three hour deluge, which started heavily, about 8 p.m. totalled 6.2 inches, more than one-seventh of a year's average.

A number of campers and motorists in the section between Aluta and Belfast had close calls last night during the severe electrical storm as Bushkill Creek was turned into a raging torrent by the cloudburst, a number of bridges being swept away.

The heaviest damage on the Pennsylvania side of the river was caused to industries and homes along Bushkill Creek, which surged upward on what was believed the worst flash flood in that stream's history. At some points, the creek rose 10 feet in two hours.

The creek for miles was lined with jagged lumber testifying to the damage done to the houses and other structures above, dozens of which must have been washed away. Many cars were washed away, some of which were seen lying in or along the creek, or jammed against trees.

Bushkill Park, with water still flowing through it late this morning, appeared severely damaged. Cottages above the park, as well as those in the park, were washed away, or twisted wreckage. Park concessions and amusements all appeared wrecked.

A group of 25 Girl Scouts from Bethlehem and 10 adult attendants and advisors had narrow escapes from being swept into the angry waters of Bushkill Creek at the famous old camping grounds at Henry's Woods. For more than five hours the party was marooned there, the raging stream which grew rapidly from a meandering brook into a rampaging river making it impossible for men or boats to get at the group.

Considerable damage was done to bridges across the Bushkill, most of which are owned by Northampton County. Front Street bridge was broken in two, with the main pier apparently undermined.

Railroad traffic was delayed by washouts and damaged bridges. Many automobiles, caught in deep water, were washed for some distance.

Another sanitary sewer to suffer was the main trunk line from West Ward and Wilson Borough, which snapped off where it crosses Bushkill Creek on a bridge above the dam near Dietrich Road. The bridge was not washed away, but it appeared bent, and was jammed with wreckage.

At its height, the Bushkill flood reached the coping of the bridge west of 4th Street.

18-19 August 1955 - Many damaging floods on the lower Bushkill were caused by a combination of rainfall on the Bushkill's watershed and a backwater condition from peak flood stages on the Delaware River. In August 1955, the second most severe flood of record was caused by this combination of conditions. Torrential rains of Hurricane Diane, preceded one week before by the heavy rainfall of Hurricane Connie, caused a flood disaster on the entire east coast of the United States. Severe flood damage and destruction occurred on the flood plain of Bushkill Creek in the City of Easton. The following special report and newspaper excerpts vividly describe this flood event:

EXCERPTS FROM THE EASTON EXPRESS, 19 AUGUST 1955 (a)

Bushkill Creek, which had its own damaging flood, was being backed by Delaware into portions of downstream Easton by mid-day

On Bushkill St - Water had reached Second St. and covered the entrance to the Lehigh Valley Thruway.

Many bridges were knocked out along surging creeks, and several important river bridges were closed. Low level area highways were closed.

Boats manned by members of the chapter's (referring to Easton Chapter of Red Cross) disaster committee spent the entire day evacuating families. The homeless were for the most part residents of South Third St. vicinity, Bushkill Drive and North Delaware Avenue.

Bushkill Creek receded rapidly yesterday after ripping its valley savagely Thursday night with a flood approaching its 1945 level.

(a) Simulated from newspaper clippings

Last night, the creek from the section below Dietrich Road was backed up to an unprecedented level by the booming Delaware Flood. Bushkill Drive was under water most of the way from cemetery bridge. The water completely covered the dam near Dietrich Rd. All houses and industries near the creek below Lehigh Valley Thruway crossing were entered.

EXCERPTS FROM A SPECIAL REPORT ENTITLED "DIANE DROWNS DELAWARE VALLEY" 18 - 19 AUGUST 1955 PUBLISHED BY THE EASTON EXPRESS, EASTON, PA.

The week preceding the disastrous days of August 18 and 19, 1955, were filled with fog, drizzle, and drenching rain. The swollen rivers and streams received on August 18 varied additional rainfall of 12 to 19 inches from Hurricane Diane's outer fringe. The saturated soil could absorb no more of the downpour.

Gentle rivers and streams became surging monsters that devoured all in their path. Bridges, roads, railroads, and buildings were swept away. Hurricane Diane delivered the Delaware Valley one of its worst disasters. More than 100 lives were lost and damages past the 100 million dollar mark. The devistation was so great that the President declared the afflicted region a "major disaster area".

President Eisenhower flew over the stricken area and directed the Federal Civil Defense Administration to initiate emergency flood relief measures.

Figures 5 and 6 provide an unusual opportunity to compare a site before and during a flood.

FIGURE 5 - Bushkill Drive at Easton, Pennsylvania, as it normally appeared during the summer of 1955

FIGURE 6 - Bushkill Drive at Easton, Pennsylvania, as it appeared during the flood of 18-19 August 1955. Note floating debris in center of photograph.

FUTURE FLOODS

Floods of the same or larger magnitude as those that have occurred in the past could occur in the future. Larger floods have been experienced in the past on streams with similar geographical and physiographical characteristics as those found in the study area. Similar combinations of rainfall and runoff which caused these floods could occur in Bushkill Creek, Easton area. Therefore, to determine the flooding potential of the study area, it was necessary to consider storms and floods that have occurred in regions of like topography, watershed cover and physical characteristics. Discussion of the future floods in this report is limited to those that have been designated as the Intermediate Regional Flood and the Standard Project Flood. The Standard Project Flood represents a reasonable upper limit of expected flooding in the study area. The Intermediate Regional Flood may reasonably be expected to occur more frequently although it will not be as severe as the infrequent Standard Project Flood.

Intermediate Regional Flood

The Intermediate Regional Flood is defined as one that could occur once in 100 years on the average, although it could occur in any year. The peak flow of this flood was developed from statistical analyses of streamflow records, precipitation records, and runoff characteristics of a watershed with similar physiographical features. In determining the Intermediate Regional Flood for Bushkill Creek, statistical studies were made using data from U.S.G.S. gaging stations on other streams throughout the Easton-Allentown, Pennsylvania, area. Peak flows from the Intermediate Regional Flood at selected locations on Bushkill Creek are shown in Table 4 on Page 15. Water surface elevations for the Intermediate Regional Flood at the same locations on Bushkill Creek are shown in Table 5 on Page 16.

Standard Project Flood

The Standard Project Flood is defined as a major flood that can be expected to occur from a severe combination of meteorological and hydrological conditions that is considered reasonably characteristic of the geographical area in which the study area is located, excluding extremely rare combinations. The Corps of Engineers, in cooperation with the NOAA Weather Service, has made comprehensive studies and investigations based on the past records of experienced storms and floods and has developed generalized procedures for estimating the flood potential of streams. Peak discharges for the Standard Project Flood at selected locations on Bushkill Creek are shown in Table 4. Water surface elevations for the Standard Project Flood at the same locations on Bushkill Creek are shown in Table 5 on Page 16. Discharge hydrographs for the Standard Project Flood above little Bushkill Creek and above Shoeneck Creek are shown on Plate 15. The water surface profiles for the Intermediate Regional Flood and the Standard Project Flood are shown on Plates 10 through 13.

TABLE 4

PEAK FLOWS FOR INTERMEDIATE REGIONAL AND STANDARD PROJECT FLOODS

Locations	Mileage Above Mouth	Intermediate Regional Flood Discharge cfs	Standard Project Flood Discharge cfs
U.S. Rt. 22 Bridge	0.45	10,000	24,500
Bushkill Drive Bridge	0.5	10,000	24,500
Bushkill Drive Bridge	1.0	10,000	24,500
Sanitary Sewer Line	1.2	10,000	24,500
13th Street Bridge	2.2	9,700	23,000
Lehigh Valley R.R. Bridge	3.8	9,700	23,000
Bushkill St. Bridge (Tatamy, Pa.)	7.1	7,200	17,000
Lehigh Valley R.R. Bridge (Stockertown, Pa.)	8.2	7,200	17,000
8th Street Bridge (Stockertown, Pa.)	8.5	5,100	11,500

During the flood of July 9, 1945, a reconnaissance team of the U.S. Army Corps of Engineers, Philadelphia District, recorded high water elevations at various crossing sites on Bushkill Creek. Table 5 shows a flood elevation comparison between the July 1945 Flood, the Intermediate Regional Flood, and the Standard Project Flood at these sites. It is important to note that in several locations the July 9, 1945, water surface elevation is shown greater than that estimated for the Intermediate Regional or the Standard Project Floods. This can be attributed to the fact that the structures were clogged with debris, causing higher water surface elevations when the measurements were taken.

TABLE 5
FLOOD ELEVATIONS

Location	Mileage Above Mouth	Water Surface Elevation (a)		
		July 9, 1945 Flood	Intermediate Regional Flood	Standard Project Flood
U.S. Rt. 22 bridge	0.45	186.3	204.6	207.2
Bushkill Drive bridge	0.5	187.9	204.6	207.2
Bushkill Drive bridge	1.0	199.0	204.6	207.2
Suspended Sanitary Sewer Line	1.2	206.8	204.6	207.2
13th St. bridge	2.2	225.0	216.0	225.7
Lehigh Valley R.R. bridge	3.8	255.6	247.6	258.4
Bushkill St. bridge (Tatamy, Pa.)	7.1	316.4	311.1	315.1
Lehigh Valley R.R. bridge (Stockertown, Pa.)	8.2	340.5	341.4	346.3
8th St. bridge (Stockertown, Pa.)	8.5	349.2	342.6	347.2

(a) Feet, mean sea level datum.

Frequency

A frequency curve of flow versus recurrence interval was constructed on the basis of computed flows up to and including the Intermediate Regional Flood. The frequency curve thus derived, which is available on request, reflects the judgment of engineers who have studied the area and are familiar with the region; however, it must be regarded as approximate and should be used with caution in connection with any planning of flood plain use. Floods larger than the Standard Project Flood are possible but the combination of factors necessary to produce such large flows would be extremely rare.

Hazards of Large Floods

The extent of damage caused by any flood depends on the topography of the area flooded, developments in the flood plain, depth and duration of flooding, velocity of

flow, and rate of rise. An Intermediate Regional Flood or Standard Project Flood on Bushkill Creek would result in inundation of residential, commercial, and industrial areas in the City of Easton and the smaller communities located upstream. Floodwater, flowing at high velocity and carrying floating debris, could create hazardous conditions for persons or vehicles attempting to cross flood areas. Specifically, floodwater that is three or more feet deep and flows at a velocity of three or more feet per second could easily sweep an adult person off his feet; this creates a definite danger of injury or drowning. Rapidly rising and swiftly flowing water may trap persons in homes that are ultimately destroyed or in vehicles that are ultimately submerged or floated. Water lines can be ruptured by deposits of debris or the force of floodwaters, thus creating the possibility of loss or contamination of domestic water supplies. Health hazards could be caused by pollution from damaged sanitary sewer lines and sewage treatment plants. Isolation of areas by floodwater could create hazards in terms of medical, fire, or law enforcement emergencies.

Flooded areas and flood damages - The areas along Bushkill Creek that would be flooded are shown on Plate 2, which is also an index map to Plates 3 through 9. Areas that would be flooded by the Intermediate Regional and Standard Project Floods are shown in detail on Plates 3 through 9. The actual limits of these overflow areas may vary somewhat from those shown on the maps because the 20-foot contour interval and scale of the maps do not permit precise plotting of the flooded area boundaries. As may be seen from these plates, floodflows from Bushkill Creek and Delaware River cover a large portion of Easton and other communities in the area. The areas that would be flooded by the Intermediate Regional and Standard Project Floods include commercial, industrial, and residential sections and the associated Streets, roads, and private and public utilities in Easton and the smaller communities of Tatamy and Stockertown. Considerable damage to these facilities would occur during an Intermediate Regional Flood. However, due to the wider extent, greater depths of flooding, higher velocity flow and longer duration of flooding during a Standard Project Flood, damage would be more severe than during an Intermediate Regional Flood. Plates 10, 11, 12, and 13 show water surface profiles of the Intermediate Regional and Standard Project Floods. Depth of flow in the channel can be estimated from these illustrations. Typical cross sections of the flood plain at selected locations together with the water surface elevation and lateral extent of the Intermediate Regional and Standard Project Floods are shown on Plate 14.

Obstructions - During floods, a debris collection at bridges or culverts could restrict floodflow and cause greater water depths (backwater effect) upstream of structures. Since the occurrence and amount of debris are indeterminate factors, only the physical characteristics of the structures were considered in preparing profiles of the Intermediate Regional and Standard Project Floods. Similarly, maps of the flooded areas show the backwater effect of obstructive bridges and culverts, but do not reflect increased water surface elevation that could be caused by debris collecting against the structures. As previously indicated, the 9 low dams within the study area have no flood control capacities nor will they seriously alter flow characteristics of floodwaters. Many of the crossings, such as bridges, pipelines, and the sluice box, are obstructive to the Intermediate Regional Flood.

A greater number are obstructive to the Standard Project Flood. In some cases, bridges may be high enough that they are not inundated by floodflows; but the approaches at lower elevations may be flooded and render the bridge impassable. Table 6 lists water surface elevations at selected bridges and culverts that may be restrictive during floodflows.

TABLE 6

ELEVATION DATA

Bridges Across Bushkill Creek

Identification	Mileage Above Mouth	Underclearance Elevation[a]	Water Surface Elevation [a]	
			Intermediate Regional Flood	Standard Project Flood
North Riverside Dr.	0.04	187.3	204.6	207.2[b]
North 3rd St., Easton	0.24	178.4	204.6	207.2[b]
U.S. Rt. 22	0.47	192.3	204.6	207.2[b]
Bushkill Dr.	0.48	182.4	204.6	207.2[b]
Bushkill Dr.	0.98	192.2	204.6	207.2[b]
Lehigh Valley R.R.	1.76	208.5	204.7	213.4
13th St., Easton	2.16	217.3	216.0	225.7
Private Rd. to Pfizer Co.	2.32	217.4	218.0	228.6
Private Rd. to Binney & Smith Co.	2.69	230.2	232.9	241.2
Edgewood Ave.	3.23	237.1	243.2	251.3
Lehigh Valley R.R.	3.79	250.1	247.6	258.4
Bushkill Dr. West	4.13	253.6	253.8	261.8
Lehigh Valley R.R.	4.56	259.5	258.7	265.5
Northwood Ave.	4.92	262.6	263.0	269.8
Stocker Mill Rd., Zucksville	5.45	266.6	272.7	277.6
Private Rd.	5.78	278.7	278.2	284.9
Iron Bridge, Abandoned	6.03	287.1	283.2	288.4
Newlin Rd.	6.33	292.6	295.4	300.4
Bushkill Dr., Tatamy	7.12	311.8	311.1	315.1
Main St., Tatamy	7.58	322.8	327.1	329.8
Lehigh Valley R.R.	8.24	330.9	341.4	346.3
8th St., Stockertown	8.50	342.8	342.6	347.2
Center St.	9.35	365.1	366.5	372.3
Pa. Rt. 191, Relocated	9.44	370.0	369.7	377.0
Erie & Lackawanna R.R.	9.88	387.2	383.5	387.4
Old File Town Rd.	10.96	408.0	408.5	411.9
Henry Rd., Belfast	11.44	420.2	420.1	424.1
Belfast Rd.	12.31	439.8	439.7	441.5
Jacobsville Rd.	13.08	465.5	463.5	468.8
Douglasville Rd.	14.15	482.4	485.7	488.8
Aluta Mill Rd.	14.68	497.1	497.6	501.7
Aluta Mill Rd.	15.34	515.2	514.7	517.0
Bushkill Center Rd.	15.64	521.4	515.6	519.8
Private Rd.	16.63	538.2	542.5	544.7
Clearfield Rd.	16.93	548.7	547.1	553.2
Hahn Rd.	17.33	561.9	558.6	562.3
Creamery Rd.	18.12	588.1	587.5	588.1
Pa. Rt. 512, Moorestown	18.97	613.7	612.0	614.9
Abandoned Bridge	18.99	613.5	613.7	617.4

TABLE 6 (Continued)

ELEVATION DATA

Bridges Across Bushkill Creek

Identification	Mileage Above Mouth	Underclearance Elevation (a)	Water Surface Elevation (a) Intermediate Regional Flood	Standard Project Flood
Bushkill Center Rd.	19.89	646.2	648.6	650.1
Copella Rd.	19.97	652.2	652.8	653.0
Private Rd. - Culverts	21.02	699.0	701.0	701.6
Mountain Rd.	21.21	701.9	702.7	705.2

(a) Feet, mean sea level datum.
(b) High water is caused by flooding on Delaware River for the Intermediate Regional Flood and the Standard Project Flood.

Velocities of flow - Water velocities during floods depend largely on the size and shape of the cross sections, conditions of the stream, and the bed slope, all of which vary on different streams and at different locations on the same stream. During an Intermediate Regional Flood, velocities of main channel flow in the middle reaches of the stream in the study area would be 7 to 9 feet per second. Water flowing at this rate is capable of causing severe erosion to streambanks and fill around bridge abutments. Such a flow is also capable of transporting large objects. In the lower and upper reaches, the velocities would be somewhat lower averaging 2 to 5 feet per second. It is expected that velocity of flow during a Standard Project Flood would be slightly higher than during an Intermediate Regional Flood. Overbank flow along Bushkill Creek would average 1 to 5 feet per second. Water flowing at 2 feet per second or less would deposit debris and silt. Table 7 lists the maximum velocities that would occur in the main channel and overbank areas of Bushkill Creek during the Intermediate Regional and Standard Project Floods.

TABLE 7

MAXIMUM VELOCITIES

BUSHKILL CREEK

Location	Mileage Above Mouth	Flood	Maximum Velocities ft. per second Channel	Overbank
Near Mouth	.01	Intermediate Regional	4.5	2.9
		Standard Project	10.9	6.9
Above Shoeneck Creek	5.77	Intermediate Regional	3.9	1.7
		Standard Project	5.5	2.8
Above Little Bushkill Creek	8.22	Intermediate Regional	8.9	3.8
		Standard Project	11.2	5.5
Downstream Unnamed Tributary	16.50	Intermediate Regional	6.9	3.2
		Standard Project	8.8	4.5

TABLE 7 (Continued)
MAXIMUM VELOCITIES
BUSHKILL CREEK

Location	Mileage Above Mouth	Flood	Maximum Velocities Channel ft. per second	Overbank ft. per second
Above Unnamed Tributary	17.89	Intermediate Regional	2.2	1.0
		Standard Project	4.0	1.9
Above Unnamed Tributary	20.20	Intermediate Regional	3.1	1.3
		Standard Project	4.3	1.9

Rates of rise and duration of flooding - The July 9, 1945, flood was one of several flash floods experienced along Bushkill Creek due to intense rainfalls that accompany severe storm fronts. Most floods, however, resulted from a series of rainfalls, with flood waters rising slowly and remaining out of banks for many hours. The City of Easton generally is subject to flooding from these general rainfall floods occurring on Delaware River. For the Standard Project Flood on Bushkill Creek, Table 8 gives the maximum rate of rise, height of rise (from 1 year flow level to maximum floodflow level), time of rise, and duration of flooding for two locations.

TABLE 8
RATE OF RISE AND DURATION
STANDARD PROJECT FLOOD

Location	Maximum Rate of Rise ft/hr.	Height of Rise ft.	Time of Rise hrs.	Duration of Flooding hrs.
Above confluence with Little Bushkill Creek at Stockertown	1.4	9.5	12	36
Above confluence with Shoeneck Creek	1.6	9.0	14	40

Photographs, future flood heights - The levels that the Intermediate Regional and Standard Project Floods are expected to reach at various locations in Northampton County are indicated on the following photographs.

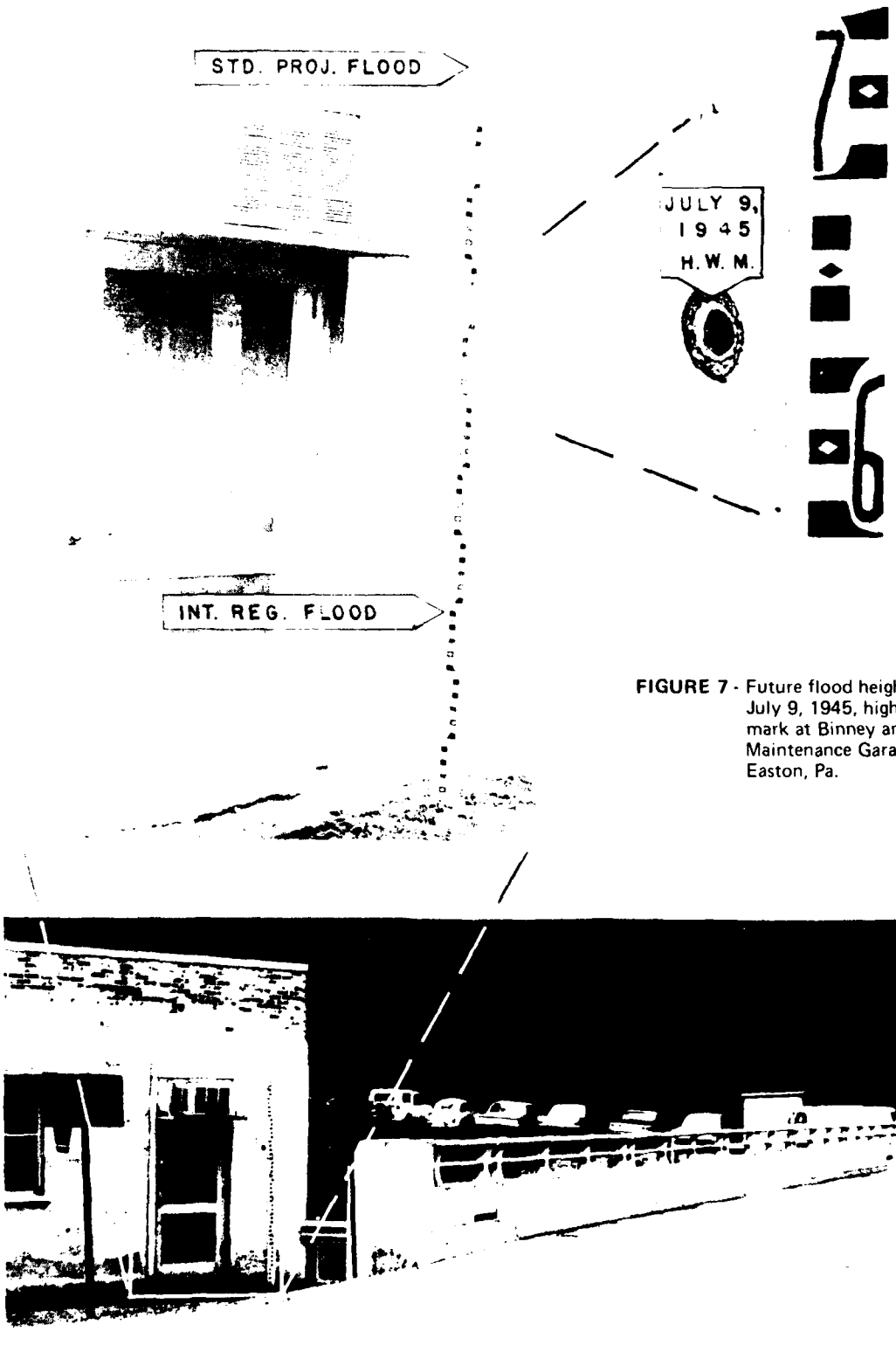


FIGURE 7 - Future flood heights and July 9, 1945, high water mark at Binney and Smith's Maintenance Garage in Easton, Pa.

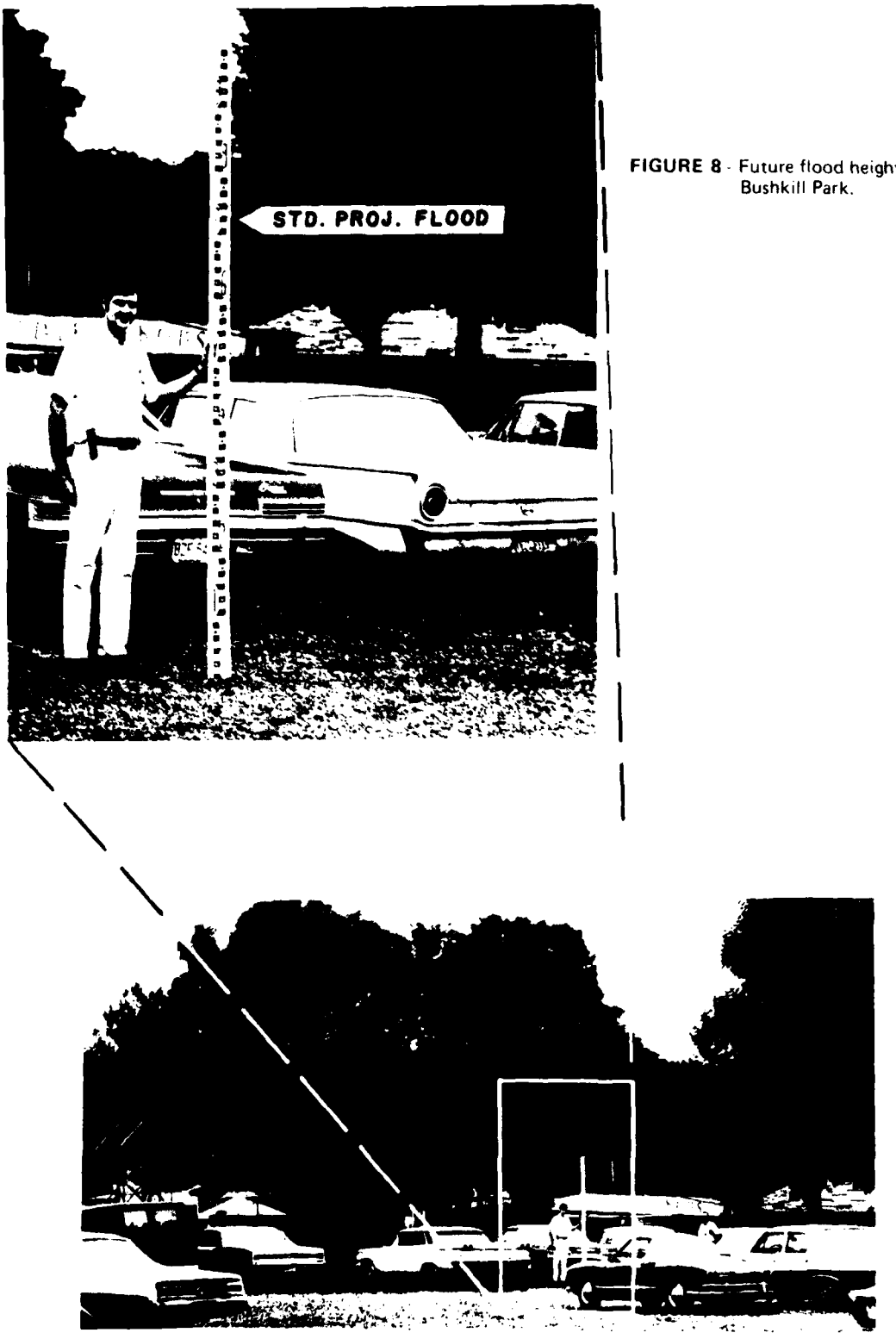
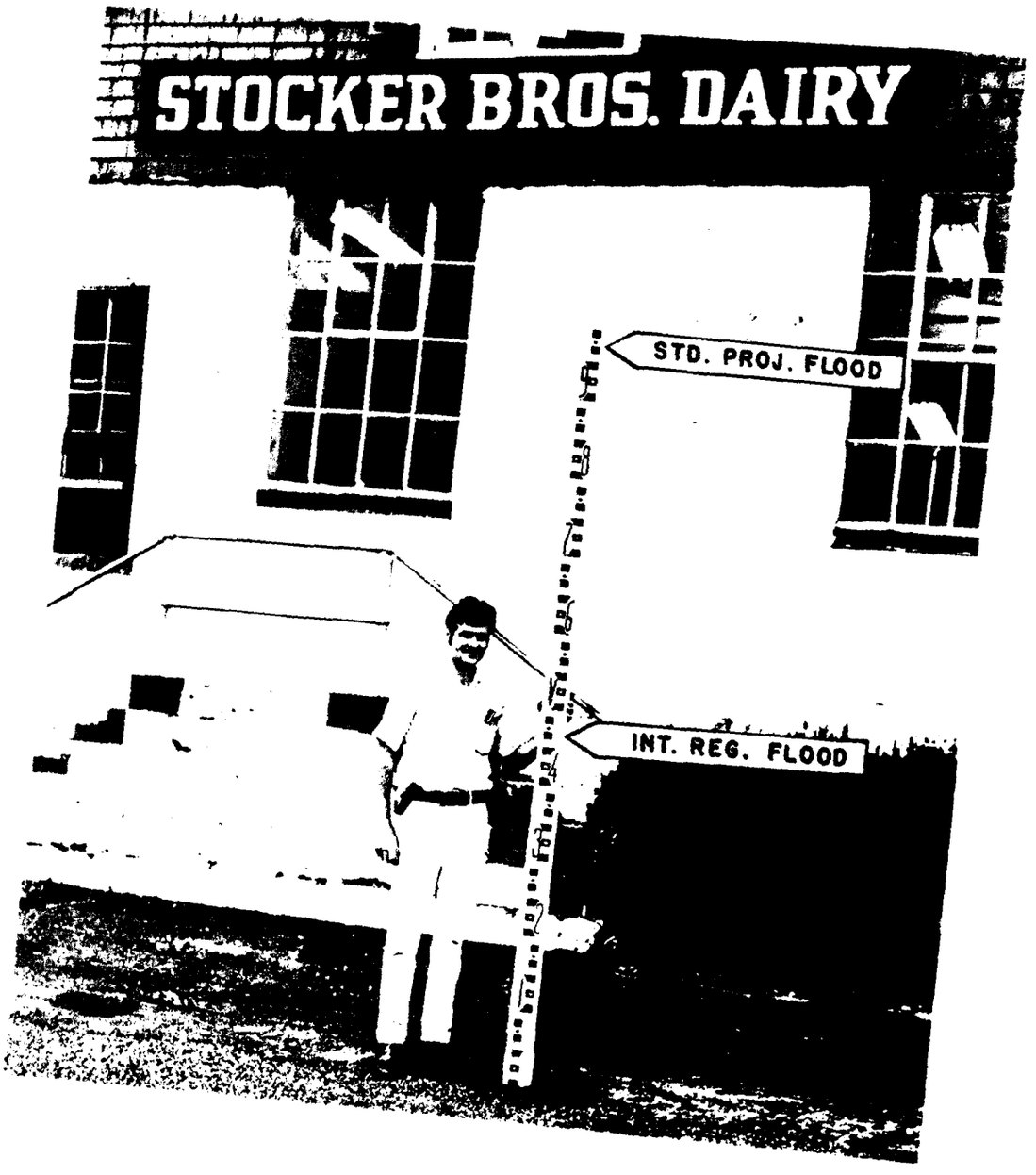


FIGURE 8 - Future flood heights at Bushkill Park.

FIGURE 9 - Future flood heights at the Stocker Bros. Dairy in Zucksville, Pa.



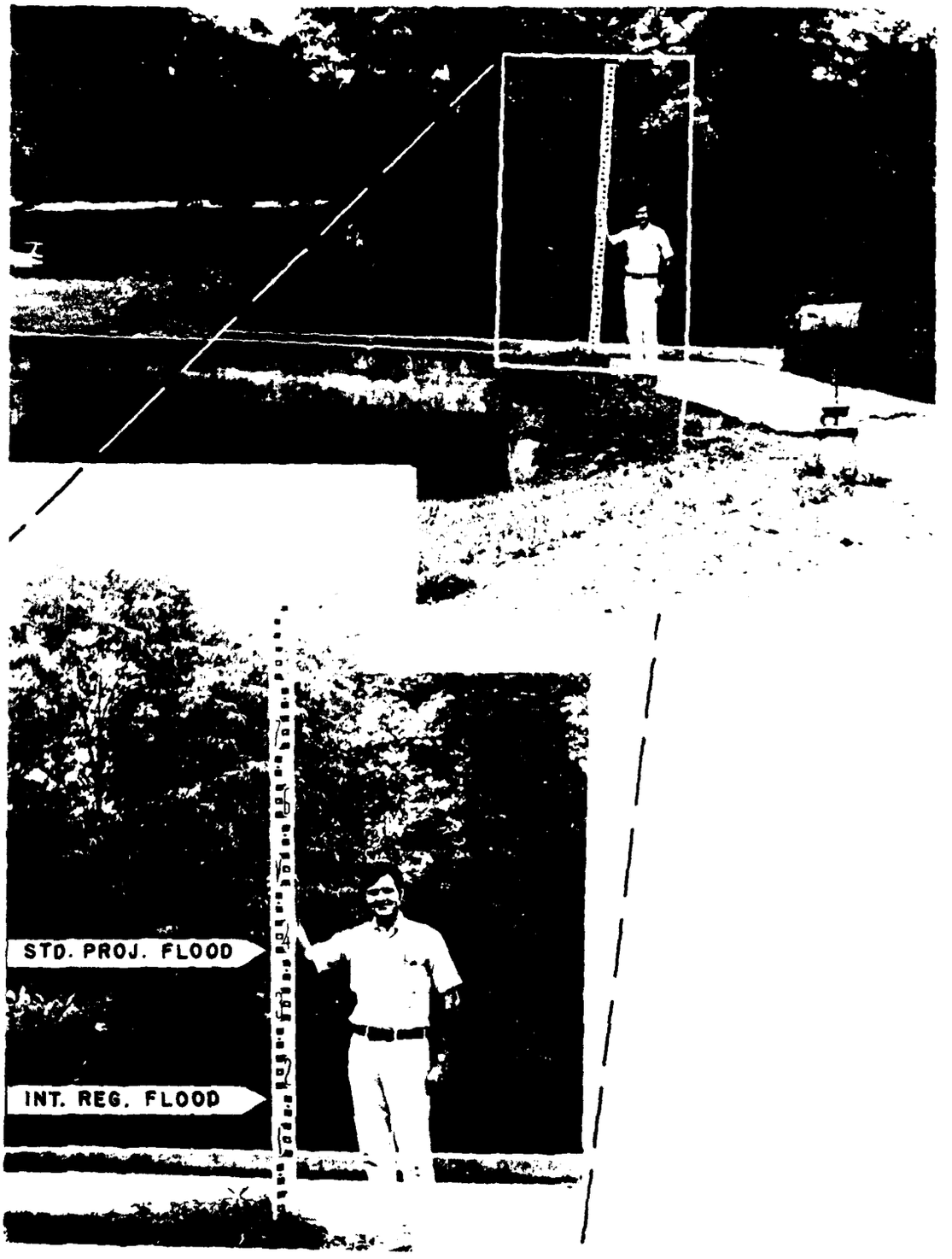


FIGURE 10 - Future flood heights at a private bridge off Douglasville Road.

GLOSSARY

Backwater. The resulting high water surface in a given stream due to a downstream obstruction or high stages in an intersecting stream.

Flood. An overflow of lands not normally covered by water and that are used or usable by man. Floods have two essential characteristics: The inundation of land is temporary; and the land is adjacent to and inundated by overflow from a river, stream, ocean, lake, or other body of standing water.

Normally a "flood" is considered as any temporary rise in streamflow or stage, but not the ponding of surface water, that results in significant adverse effects in the vicinity. Adverse effects may include damages from overflow of land areas, temporary backwater effects in sewers and local drainage channels, creation of unsanitary conditions or other unfavorable situations by deposition of materials in stream channels during flood recessions, rise of ground water coincident with increased streamflow, and other problems.

Flood Crest. The maximum stage or elevation reached by the waters of a flood at a given location.

Flood Plain. The areas adjoining a river, stream, watercourse, ocean, lake or other body of standing water that have been or may be covered by floodwater.

Flood Profile. A graph showing the relationship of water surface elevation to location, the latter generally expressed as distance above mouth for a stream of water flowing in an open channel. It is generally drawn to show surface elevation for the crest of a specific flood, but may be prepared for conditions at a given time or stage.

Flood Stage. The stage or elevation at which overflow of the natural banks of a stream or body of water begins in the reach or area in which the elevation is measured.

Hurricane. An intense cyclonic windstorm of tropical origin in which winds tend to spiral inward in a counterclockwise direction toward a core of low pressure, with maximum surface wind velocities that equal or exceed 75 miles per hour (65 knots) for several minutes or longer at some points. Tropical storm is the term applied if maximum winds are less than 75 miles per hour.

Hydrograph. A graph showing flow values against time at a given point, usually measured in cubic feet per second. The area under the curve indicates total volume of flow.

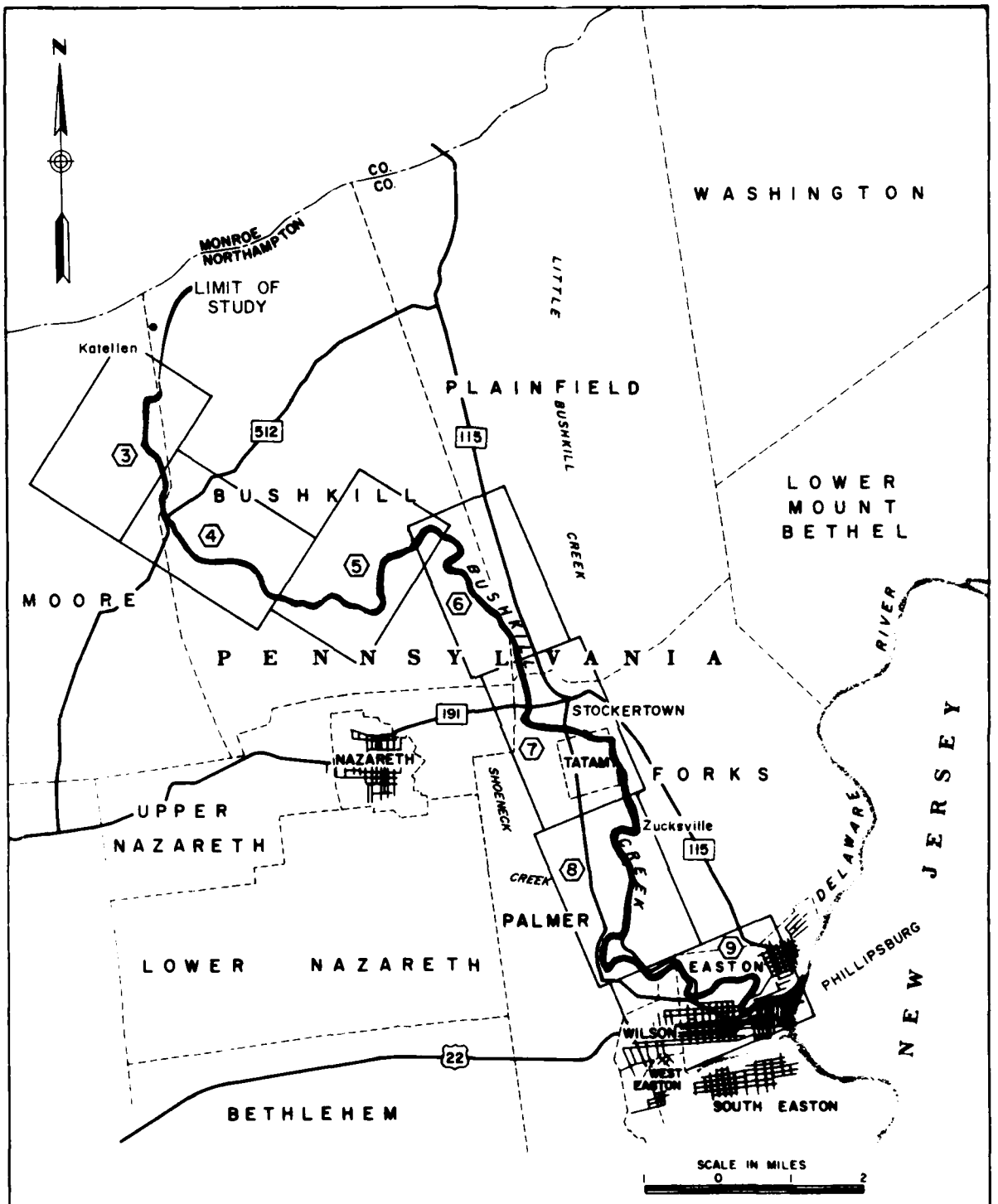
Intermediate Regional Flood. A flood having an average frequency of occurrence in the order of once in 100 years although the flood may occur in any year. It is based on statistical analyses of streamflow records available for the watershed and analyses of rainfall and runoff characteristics in the general region of the watershed.

Left Bank. The bank on the left side of a river, stream, or watercourse, looking downstream.

Right Bank. The bank on the right side of a river, stream, or watercourse, looking downstream.

Standard Project Flood. The flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonably characteristic of the geographical area in which the drainage basin is located, excluding extremely rare combinations. Peak discharges for these floods are generally about 40-60 percent of the Probable Maximum Floods for the same basins. As used by the Corps of Engineers, Standard Project Floods are intended as practicable expressions of the degree of protection that should be sought in the design of flood control works, the failure of which might be disastrous.

Underclearance Elevation. The elevation at the top of the opening of a culvert, or other structure through which water may flow along a watercourse.



LEGEND

(3) PLATE NUMBER

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

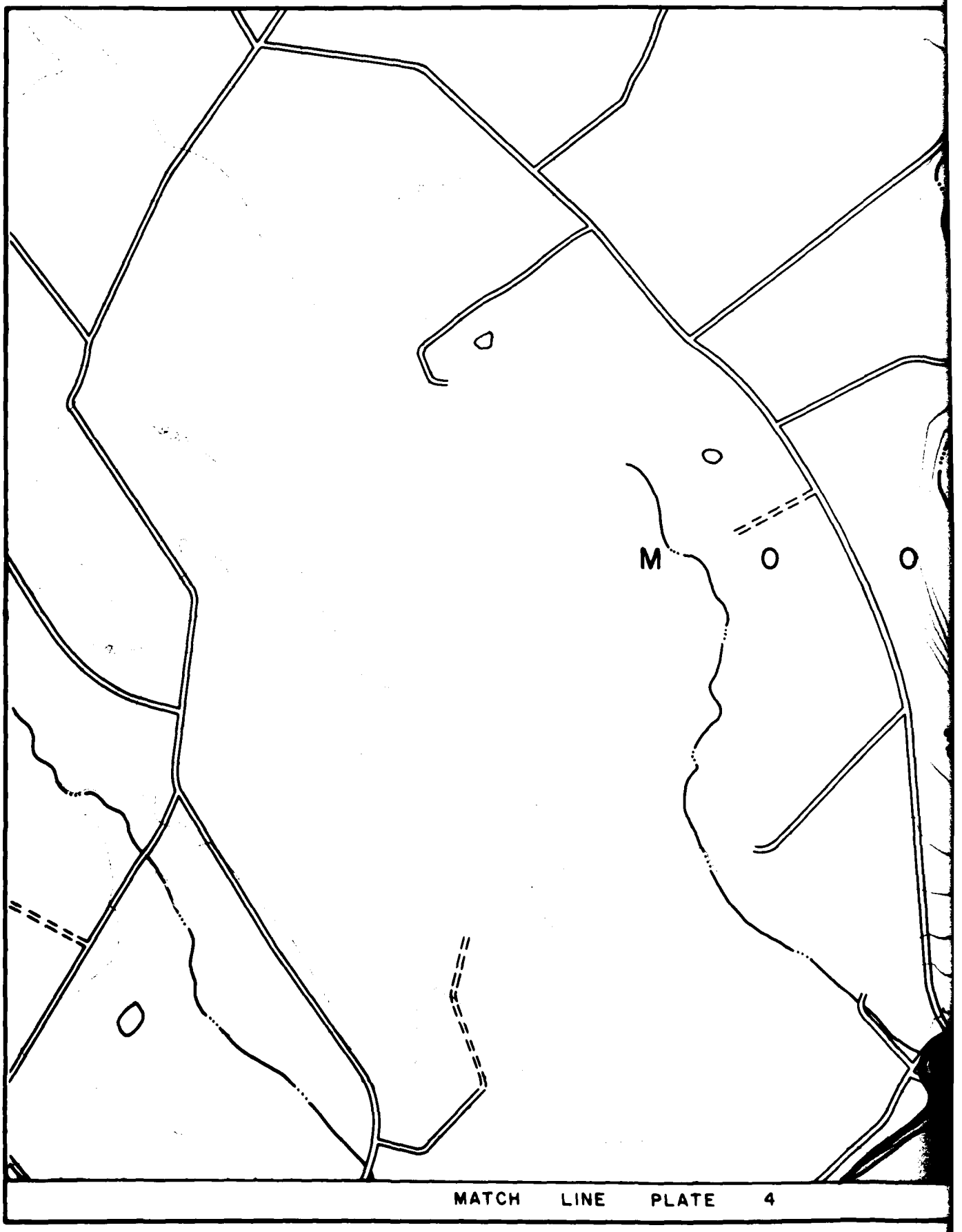
FLOOD PLAIN INFORMATION

BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

INDEX MAP - FLOODED AREAS

JANUARY 1972

PLATE 2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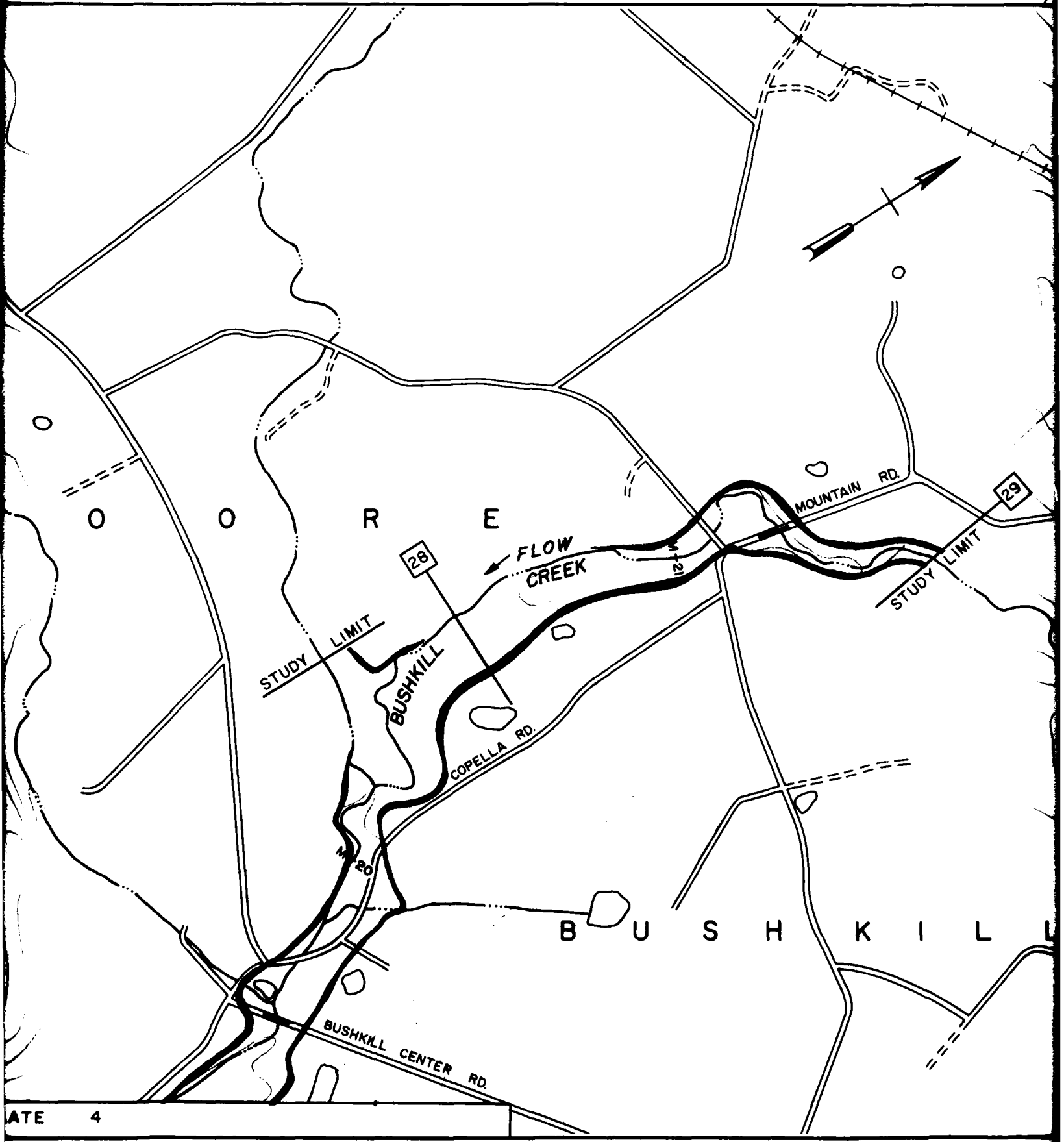
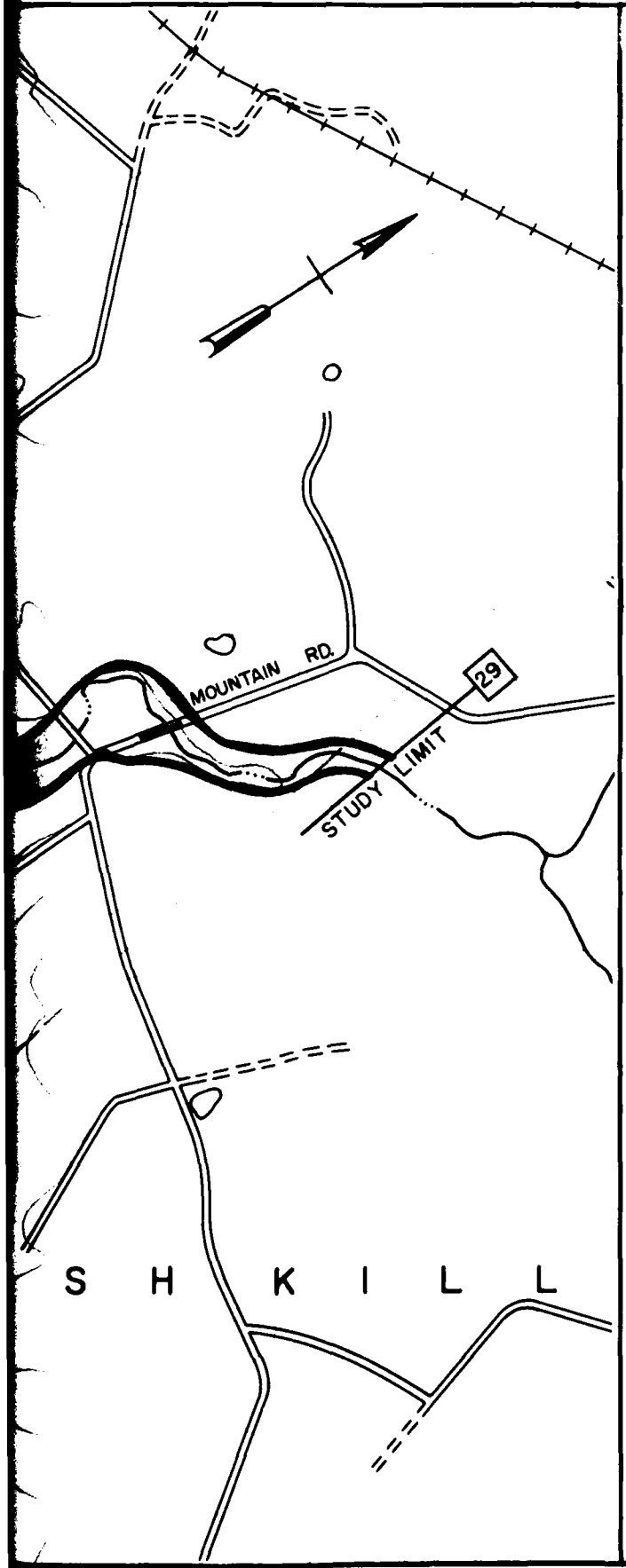
MATCH LINE PLATE 4


O O R E
BUSHKILL
28
29
FLOW
CREEK
STUDY LIMIT
STUDY LIMIT
BUSHKILL
COPELLA RD.
MOUNTAIN RD.
BUSHKILL CENTER RD.
M-20
ATE 4



LEGEND

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M+20 MILES ABOVE MOUTH

28 CROSS SECTION

GROUND ELEVATION IN FEET (U.S.C & G.S. 1929 ADJ.) SEA LEVEL DATUM

STREAM CENTERLINE

CITY OR TOWNSHIP LIMITS

NOTES

1. MAP BASED ON U.S.G.S. 7.5 MIN. QUADRANGLE SHEETS EASTON-1956, NAZARETH-1964 & WINDGAP-1960. MINOR ADDITIONS AND ADJUSTMENTS MADE BY CORPS OF ENGINEERS.
2. LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.
3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. MINIMUM CONTOUR INTERVAL IS 20 FT.

SCALE IN FEET

0 800 1600

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

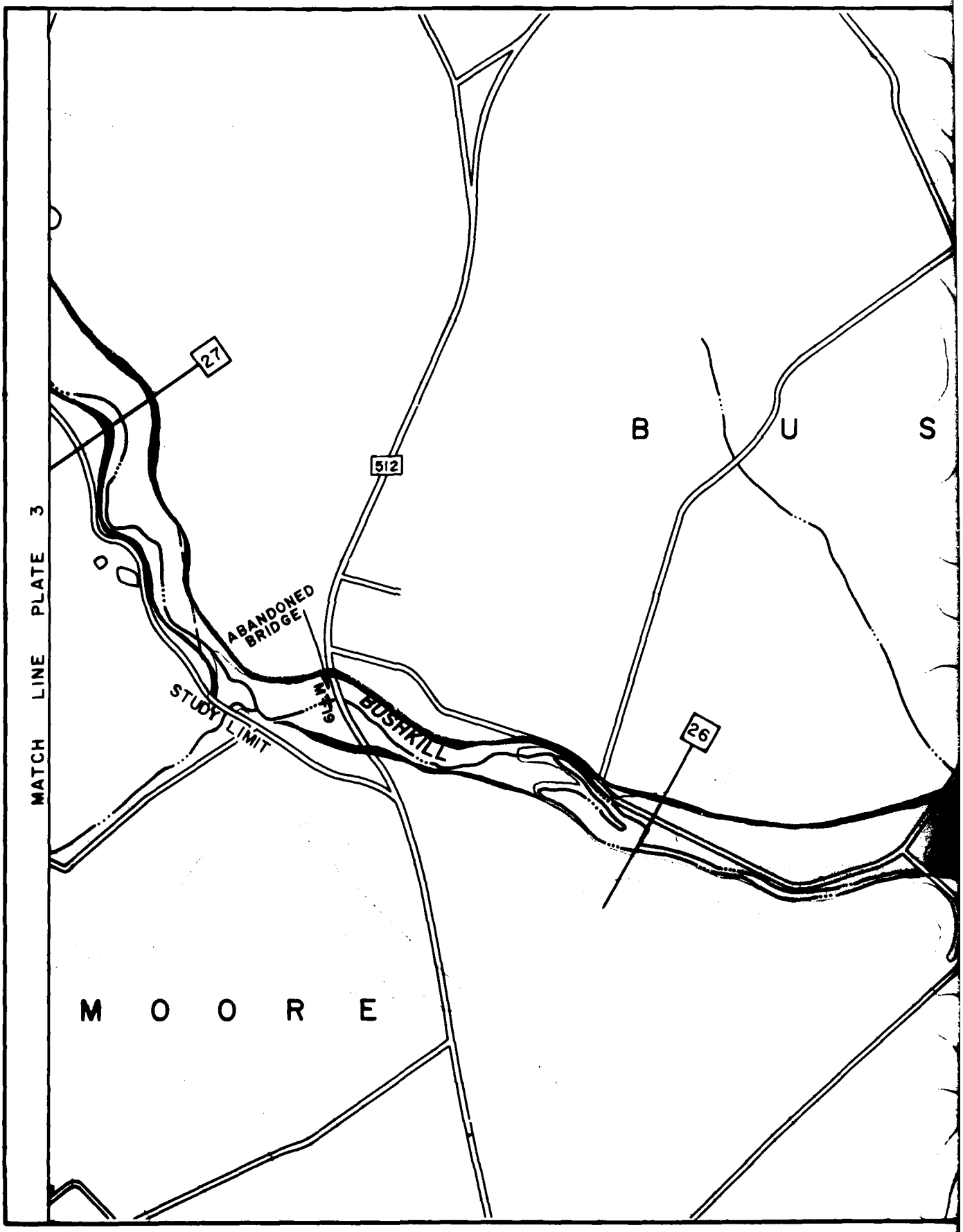
FLOOD PLAIN INFORMATION

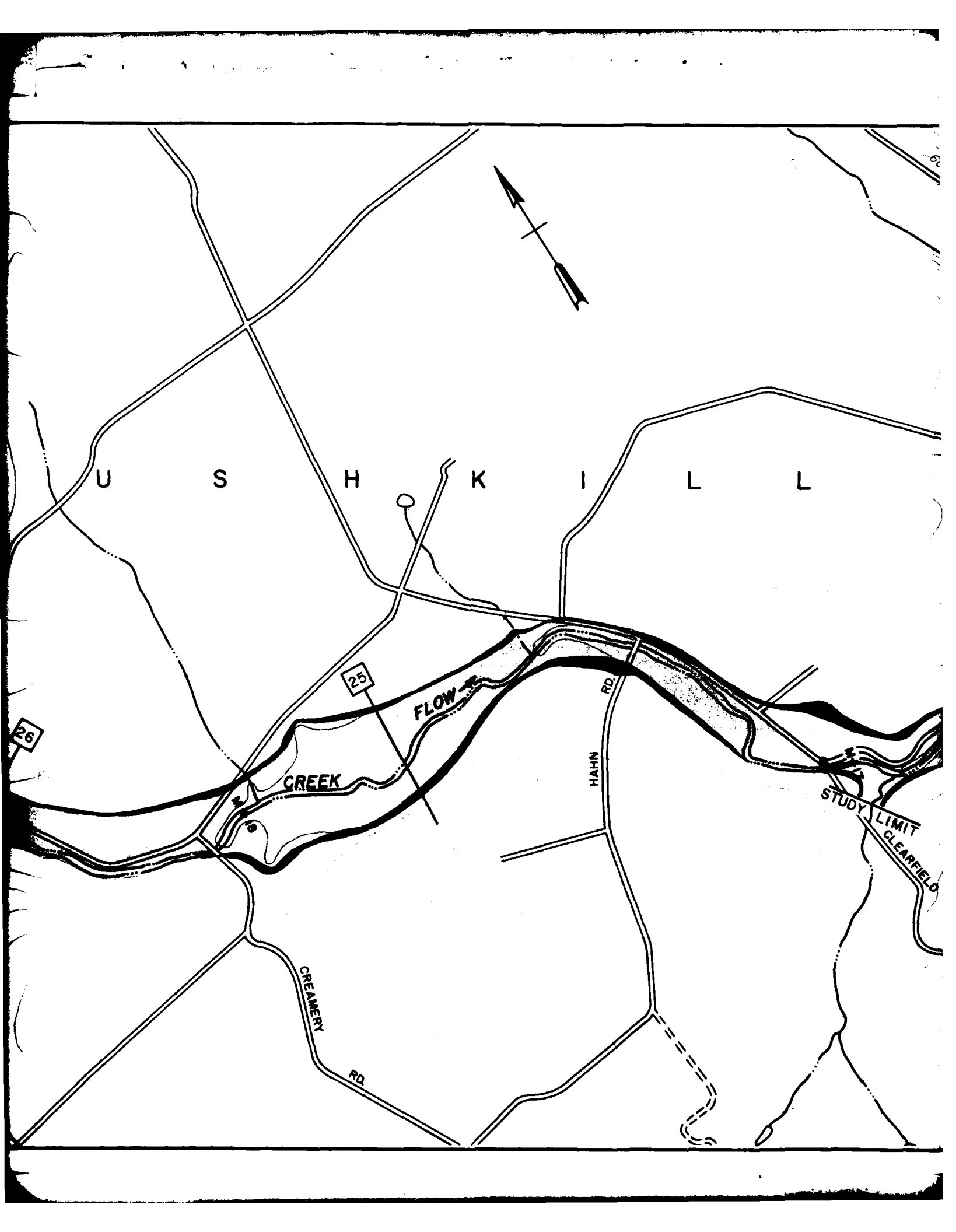
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

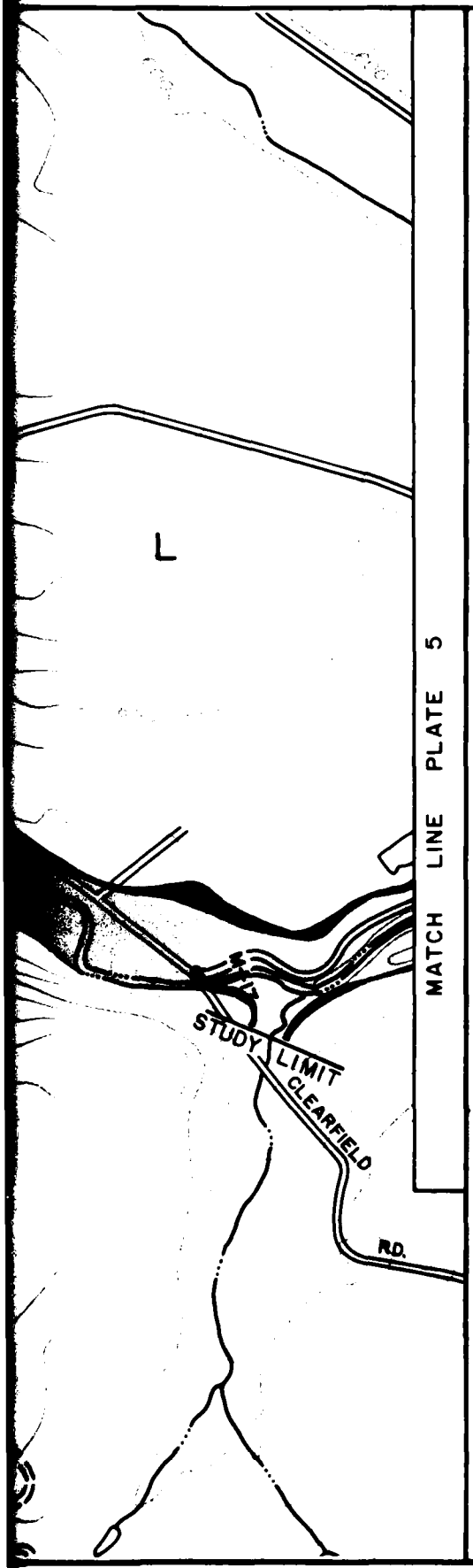
FLOODED AREAS

JANUARY 1972

PLATE 3


MATCH LINE PLATE 3
27
512
B U S
ABANDONED BRIDGE
STUDY LIMIT
M719
BUSHKILL
26
M O O R E


U S H K I L L
25
26
FLOW
CREEK
HAHN RD.
STUDY LIMIT
CLEARFIELD
CREAMERY RD.



LEGEND

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M+19 MILES ABOVE MOUTH

26 CROSS SECTION

GROUND ELEVATION IN FEET (U.S.C & G.S. 1929 ADJ.) SEA LEVEL DATUM

CHANNEL

CITY OR TOWNSHIP LIMITS

512 STATE HIGHWAY

NOTES

1. MAP BASED ON U.S.G.S. 7.5 MIN. QUADRANGLE SHEETS EASTON-1956, NAZARETH-1964 & WINDGAP-1960. MINOR ADDITIONS AND ADJUSTMENTS MADE BY CORPS OF ENGINEERS.
2. LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.
3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. MINIMUM CONTOUR INTERVAL IS 20 FT.

SCALE IN FEET

0 800 1600

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

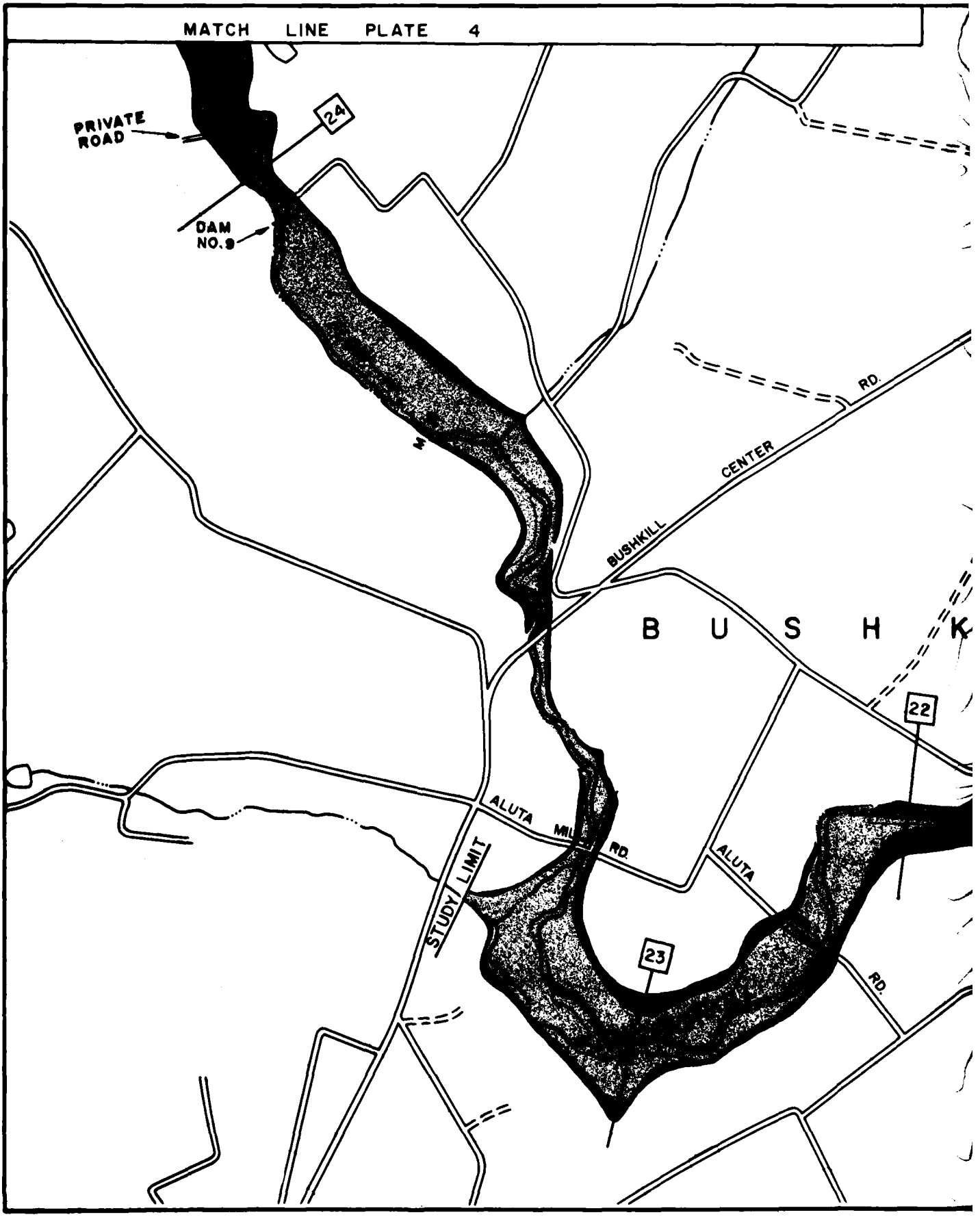
FLOOD PLAIN INFORMATION

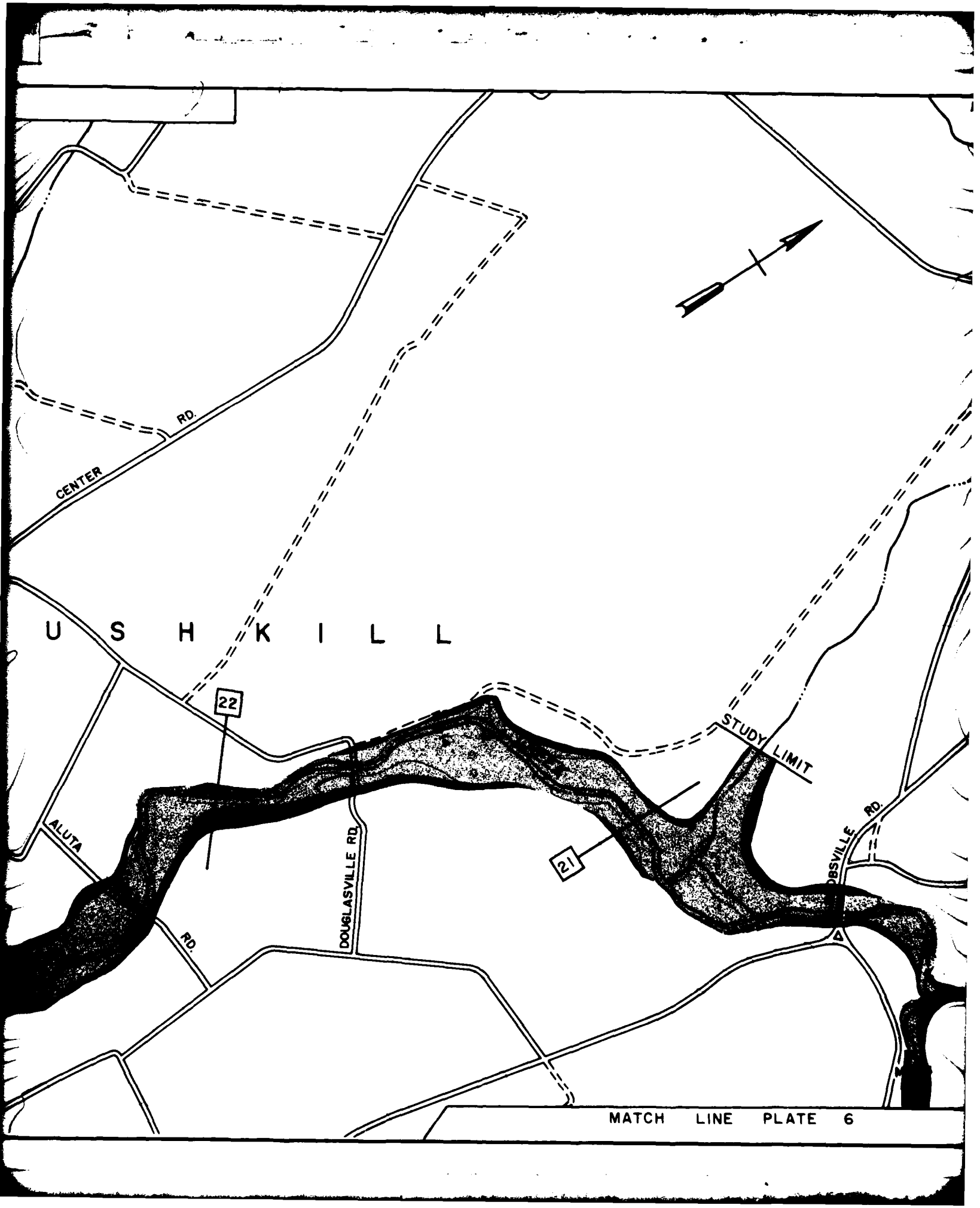
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

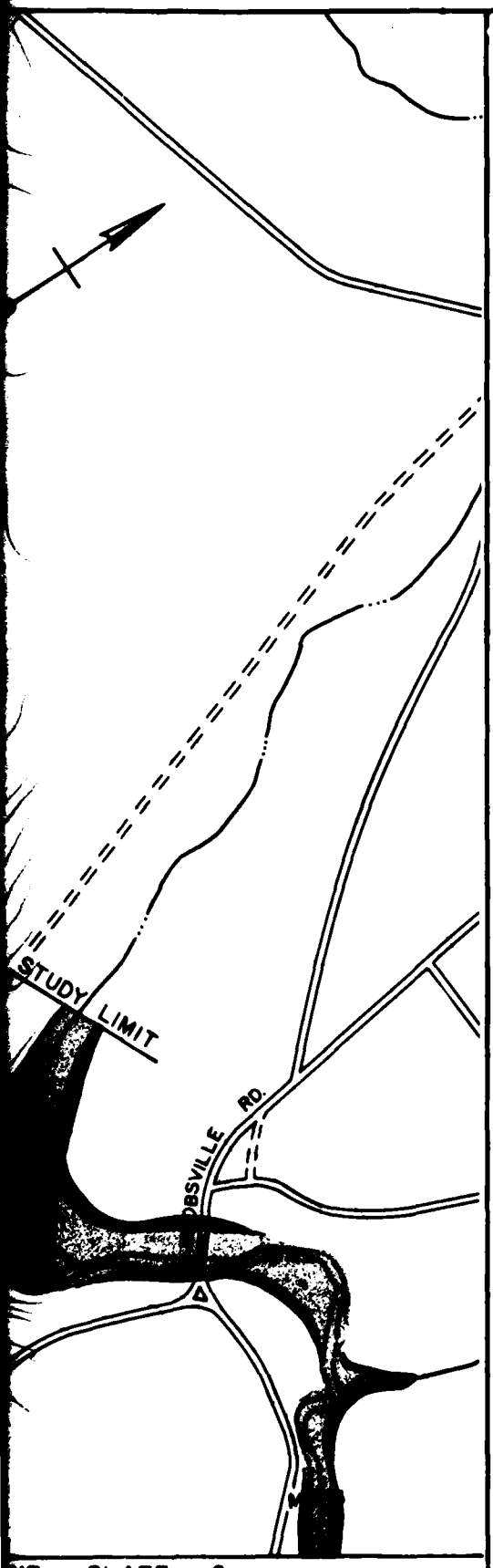
FLOODED AREAS

JANUARY 1972

PLATE 4


MATCH LINE PLATE 4
PRIVATE ROAD
24
DAM NO. 9
RD.
CENTER
BUSHKILL
B U S H K
22
ALUTA
RD.
STUDY LIMIT
ALUTA
23
RD.


RD.
CENTER
U S H K I L L
22
STUDY LIMIT
ALUTA
DOUGLASVILLE RD.
21
RD.
MATCH LINE PLATE 6



LEGEND

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M+15 MILES ABOVE MOUTH

22 CROSS SECTION

GROUND ELEVATION IN FEET (U.S.C & G.S. 1929 ADJ.) SEA LEVEL DATUM

CHANNEL

NOTES

1. MAP BASED ON U.S.G.S. 7.5 MIN. QUADRANGLE SHEETS EASTON-1956, NAZARETH-1964 & WINDGAP-1960 MINOR ADDITIONS AND ADJUSTMENTS MADE BY CORPS OF ENGINEERS.
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3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. MINIMUM CONTOUR INTERVAL IS 20 FT.

SCALE IN FEET

0 800 1600

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

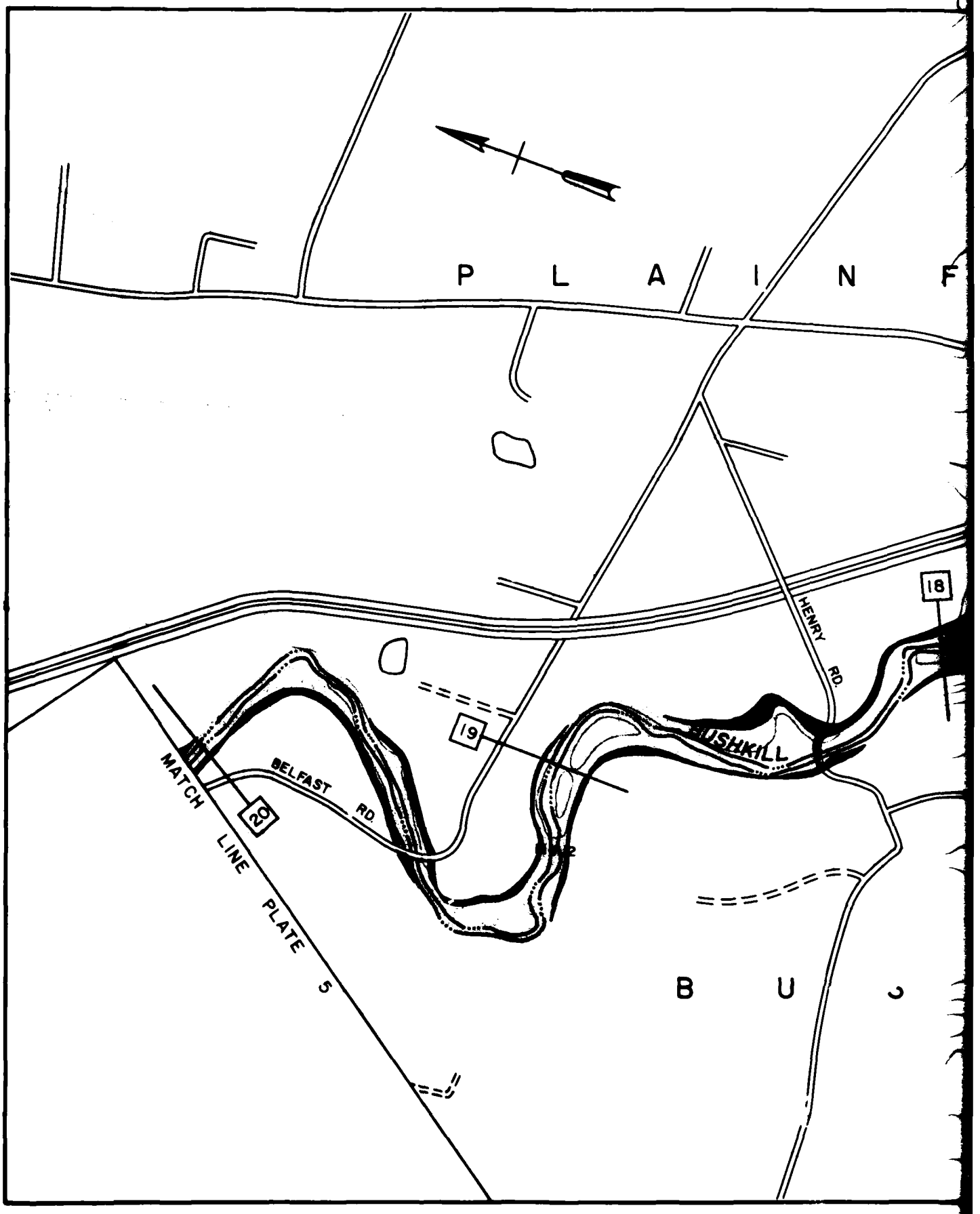
FLOOD PLAIN INFORMATION

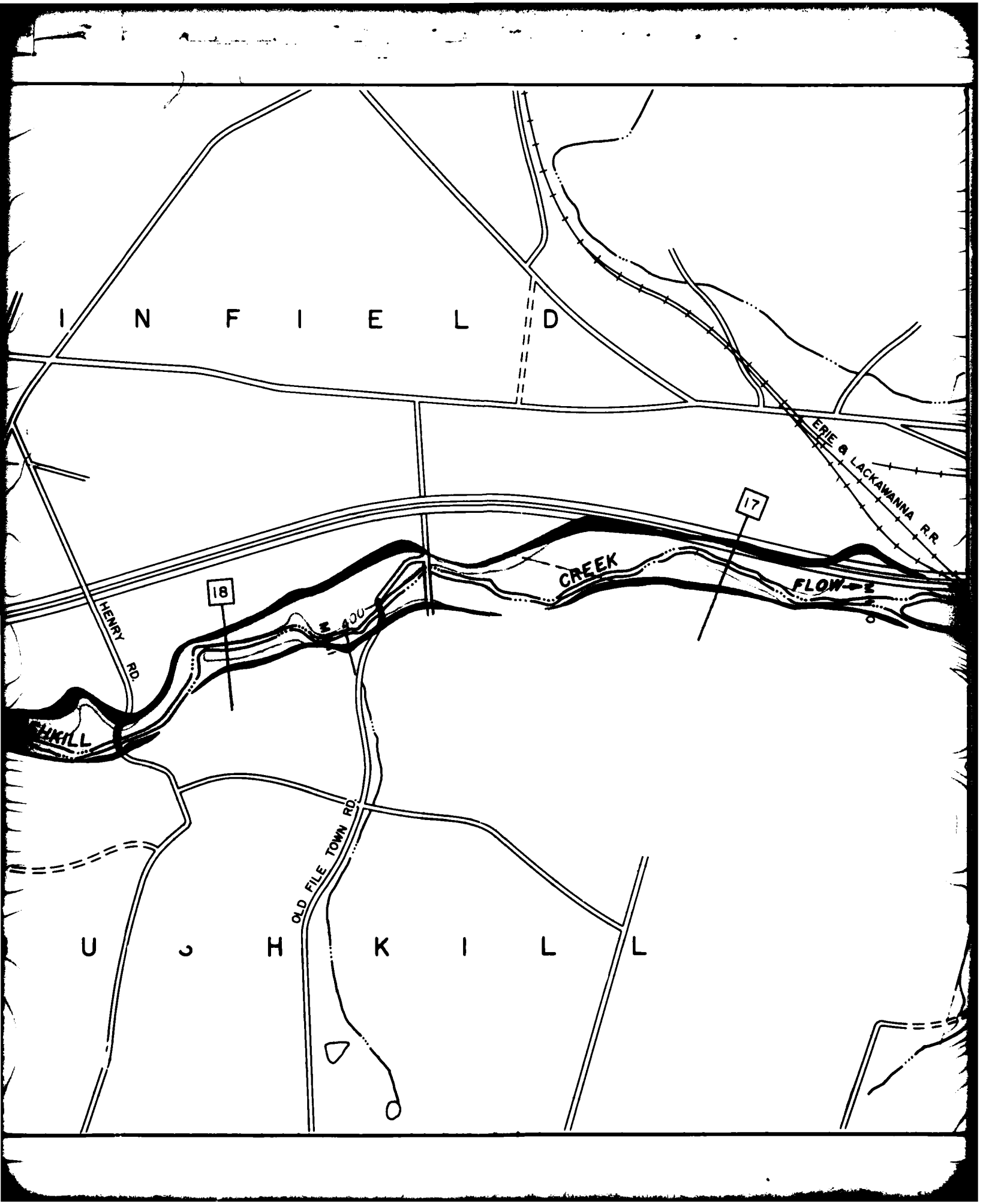
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

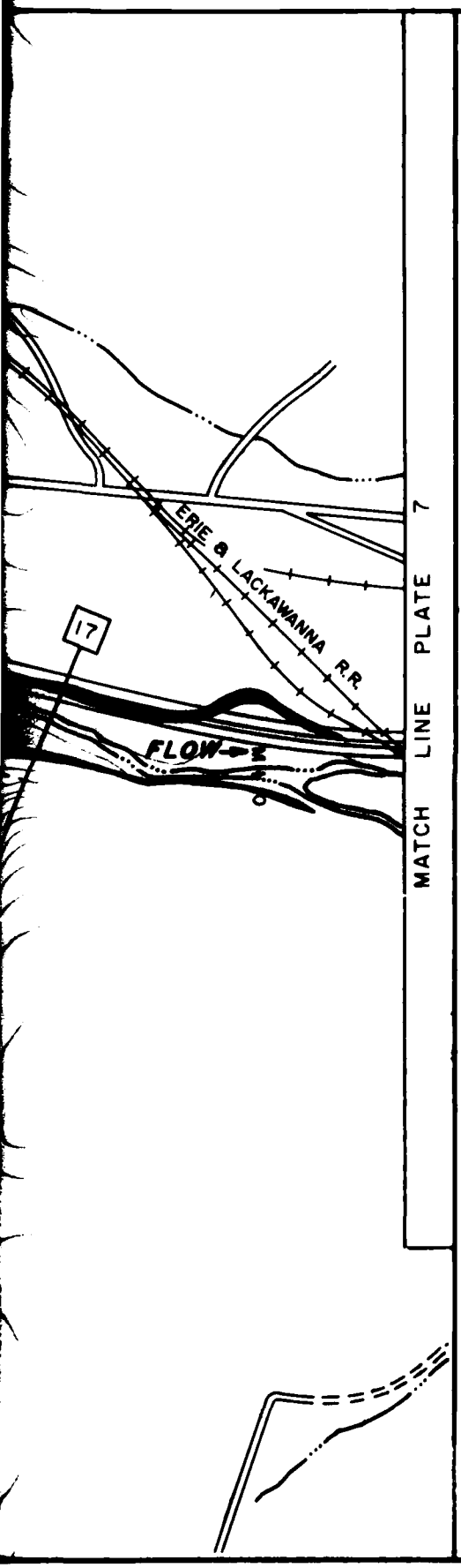
FLOODED AREAS
JANUARY 1972

NE PLATE 6

PLATE 5


P L A I N F
HENRY RD.
18
19
ISHKILL
BELFAST RD.
20
MATCH LINE PLATE 5
B U


I N F I E L D
ERIE & LACKAWANNA R.R.
17
18
CREEK
FLOW
HENRY RD.
OLD FILE TOWN RD.
U H K I L L



MATCH LINE PLATE 7

LEGEND

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M+12 MILES ABOVE MOUTH

19 CROSS SECTION

GROUND ELEVATION IN FEET (USC & GS 1929 ADJ.) SEA LEVEL DATUM

CHANNEL

CITY OR TOWNSHIP LIMITS

NOTES

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2. LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT.
3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. MINIMUM CONTOUR INTERVAL IS 20 FT.

SCALE IN FEET

0 800 1600

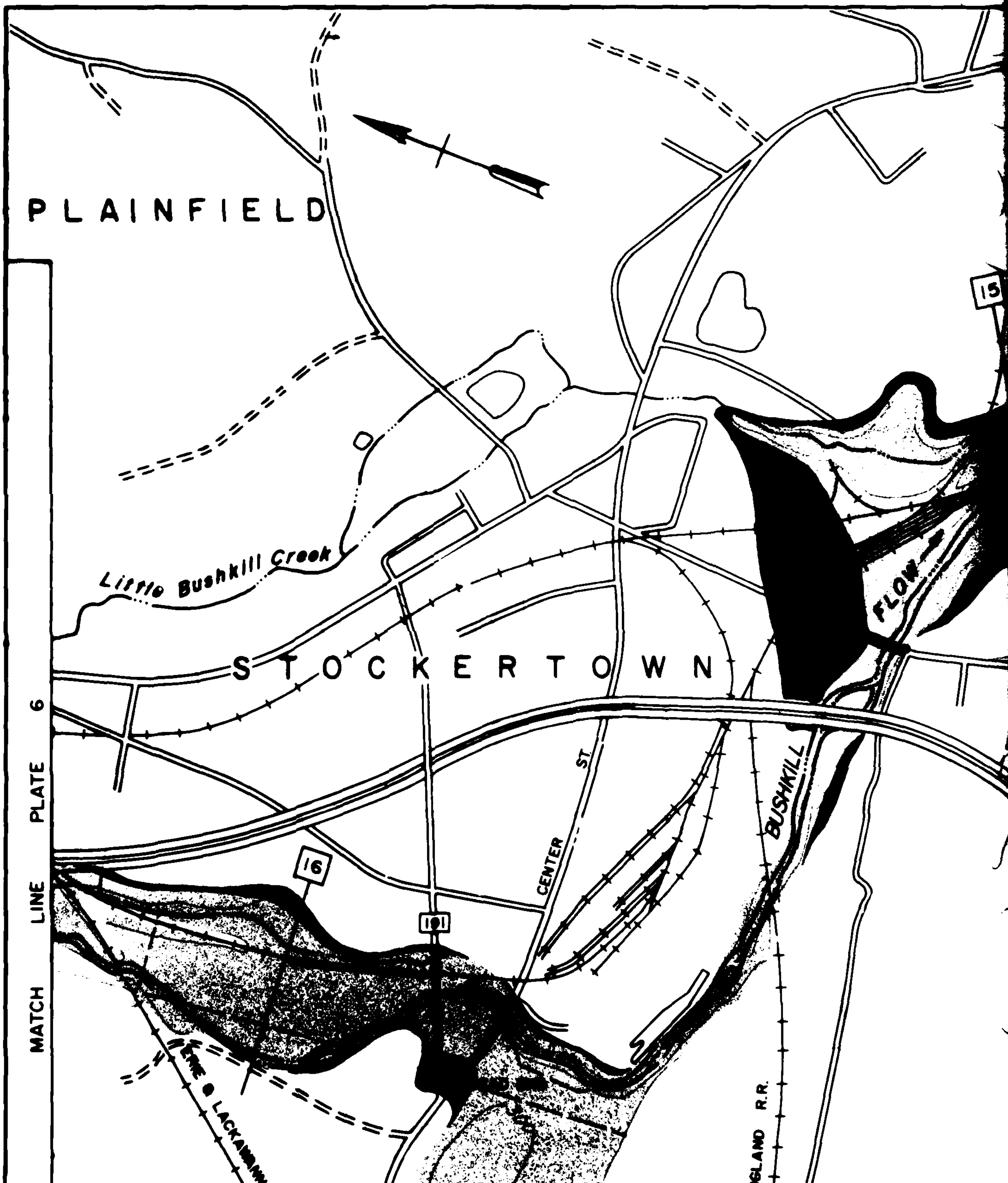
DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

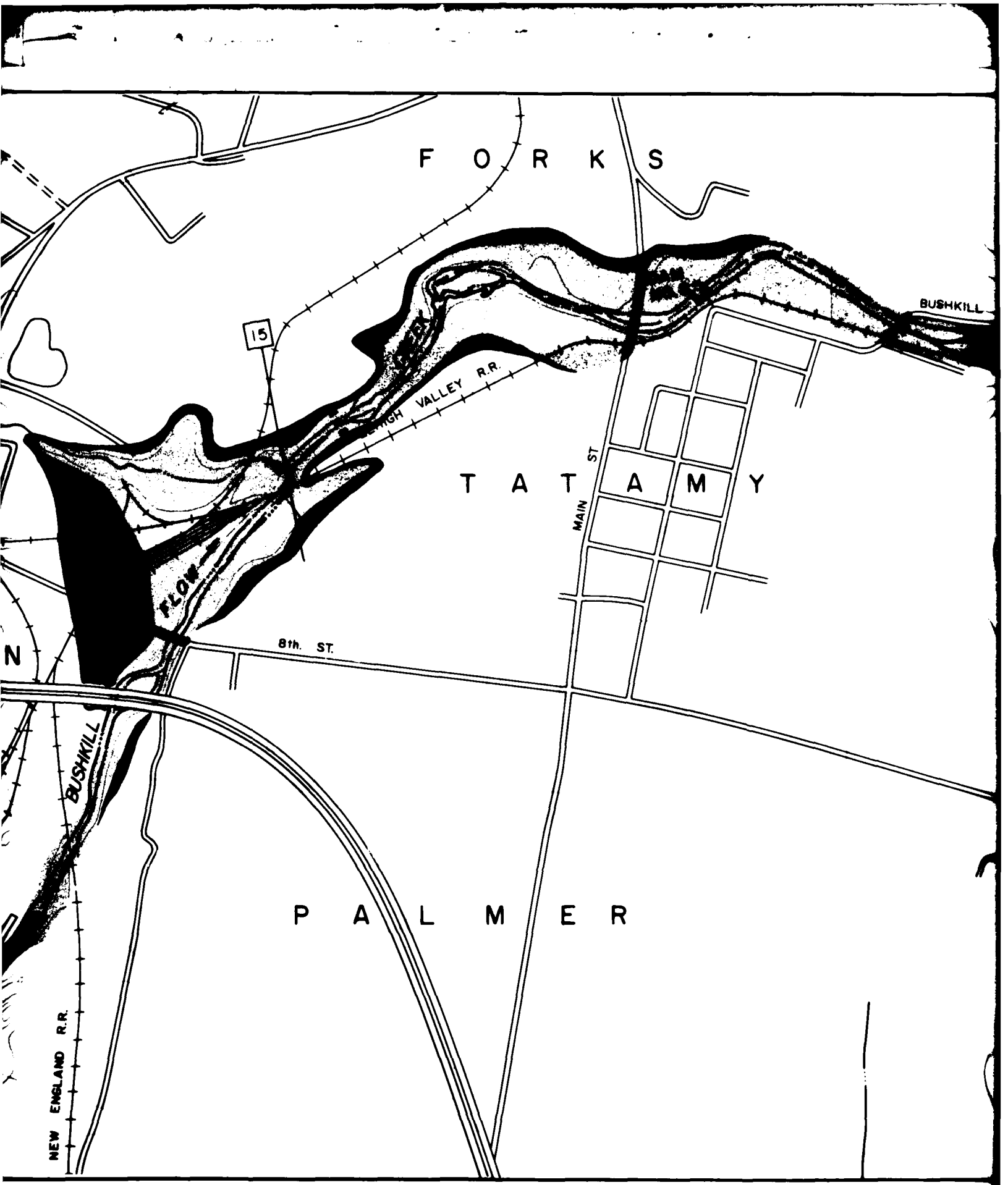
FLOOD PLAIN INFORMATION

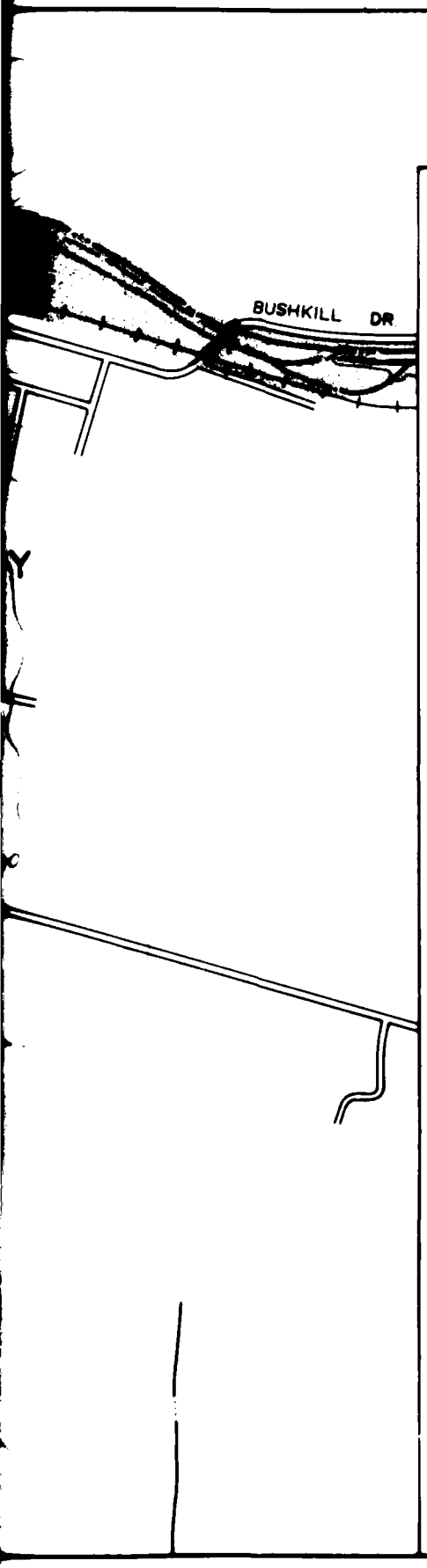
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

FLOODED AREAS
JANUARY 1972

PLATE 6


PLAINFIELD
15
Little Bushkill Creek
FLOW
STOCKERTOWN
MATCH LINE PLATE 6
CENTER ST.
BUSHKILL
16
191
ERIE & LACKAWANNA R.R.
NEW ENGLAND R.R.
UPPER NAZARETH


F O R K S
BUSHKILL
15
LEHIGH VALLEY R.R.
MAIN ST
T A T A M Y
FLOW
8th. ST.
N
BUSHKILL
P A L M E R
NEW ENGLAND R.R.



LEGEND

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M+8 MILES ABOVE MOUTH

16 CROSS SECTION

GROUND ELEVATION IN FEET (USC & GS 1929 ADJ) SEA LEVEL DATUM

CHANNEL

CITY OR TOWNSHIP LIMITS

191 STATE HIGHWAY

NOTES

1 MAP BASED ON USGS 7.5 MIN QUADRANGLE SHEETS EASTON-1956, NAZARETH-1964 & WINDGAP-1960 MINOR ADDITIONS AND ADJUSTMENTS MADE BY CORPS OF ENGINEERS

2 LIMITS OF OVERFLOW SHOWN MAY VARY FROM ACTUAL LOCATION ON GROUND AS EXPLAINED IN THE REPORT

3 AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF

4 MINIMUM CONTOUR INTERVAL IS 20 FT

SCALE IN FEET

0 800 1600

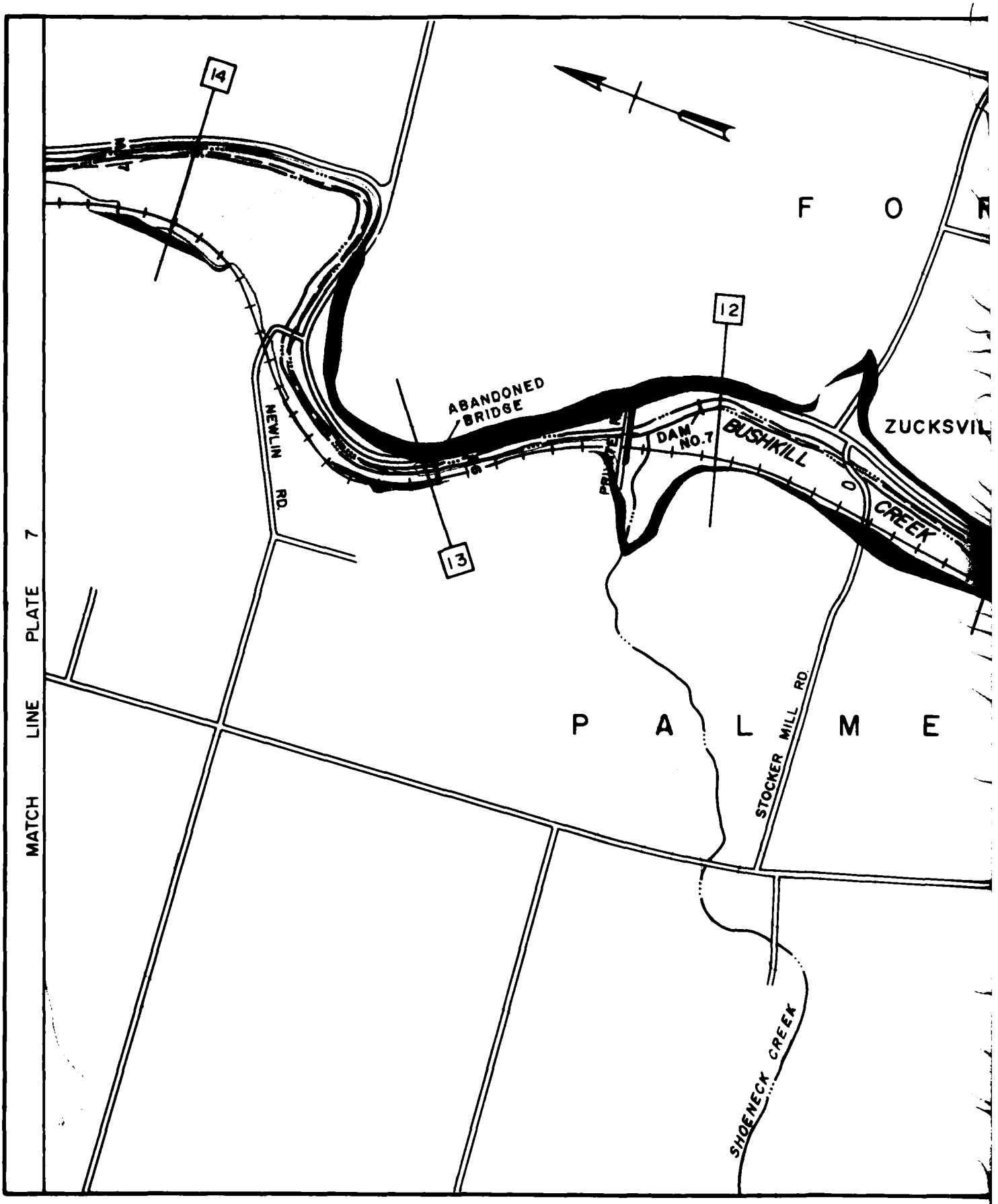
DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

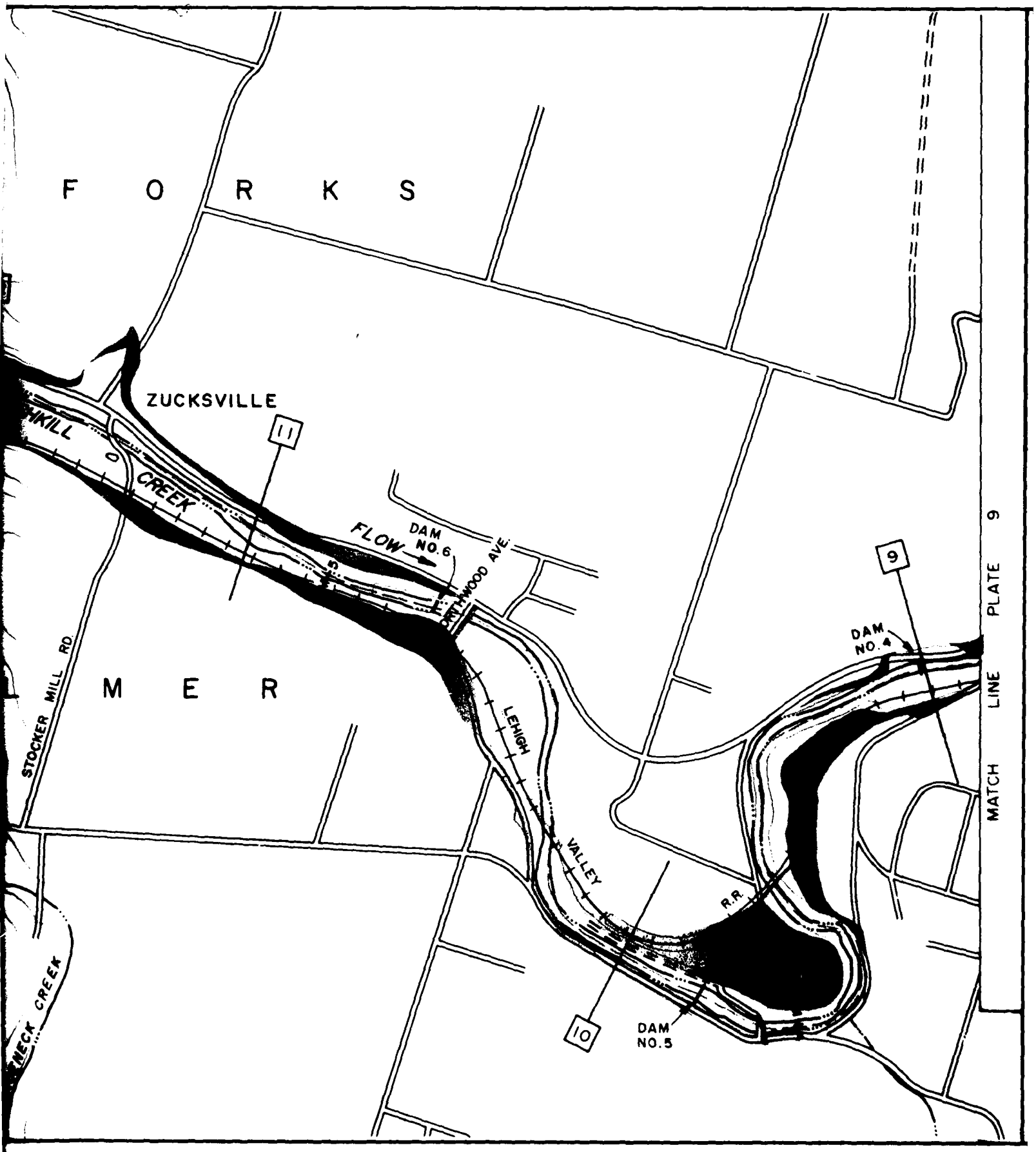
FLOOD PLAIN INFORMATION

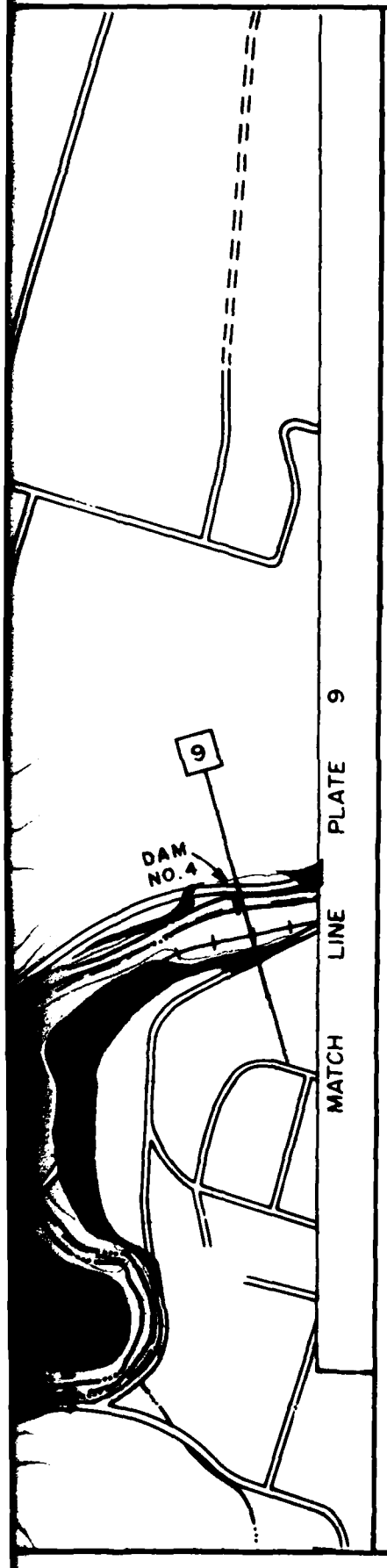
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

FLOODED AREAS
JANUARY 1972

PLATE 7


14
13
12
ABANDONED BRIDGE
NEWLIN RD.
DAM NO. 7
BUSHKILL CREEK
ZUCKSVIL
F O R
P A L M E
STOCKER MILL RD.
SHOENECK CREEK
MATCH LINE PLATE 7


F O R K S
ZUCKSVILLE
KILL
CREEK
FLOW
DAM NO. 6
SMITHWOOD AVE
11
9
DAM NO. 4
M E R
STOCKER MILL RD.
LEHIGH
VALLEY
R.R.
10
DAM NO. 5
MECK CREEK
MATCH LINE PLATE 9



LEGEND

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD — STANDARD PROJECT FLOOD

M+5 MILES ABOVE MOUTH

13 CROSS SECTION

GROUND ELEVATION IN FEET (U.S.C. & G.S. 1929 ADJ.) SEA LEVEL DATUM

CHANNEL

CITY OR TOWNSHIP LIMITS

NOTES

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3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. MINIMUM CONTOUR INTERVAL IS 20 FT.

SCALE IN FEET

0 800 1600

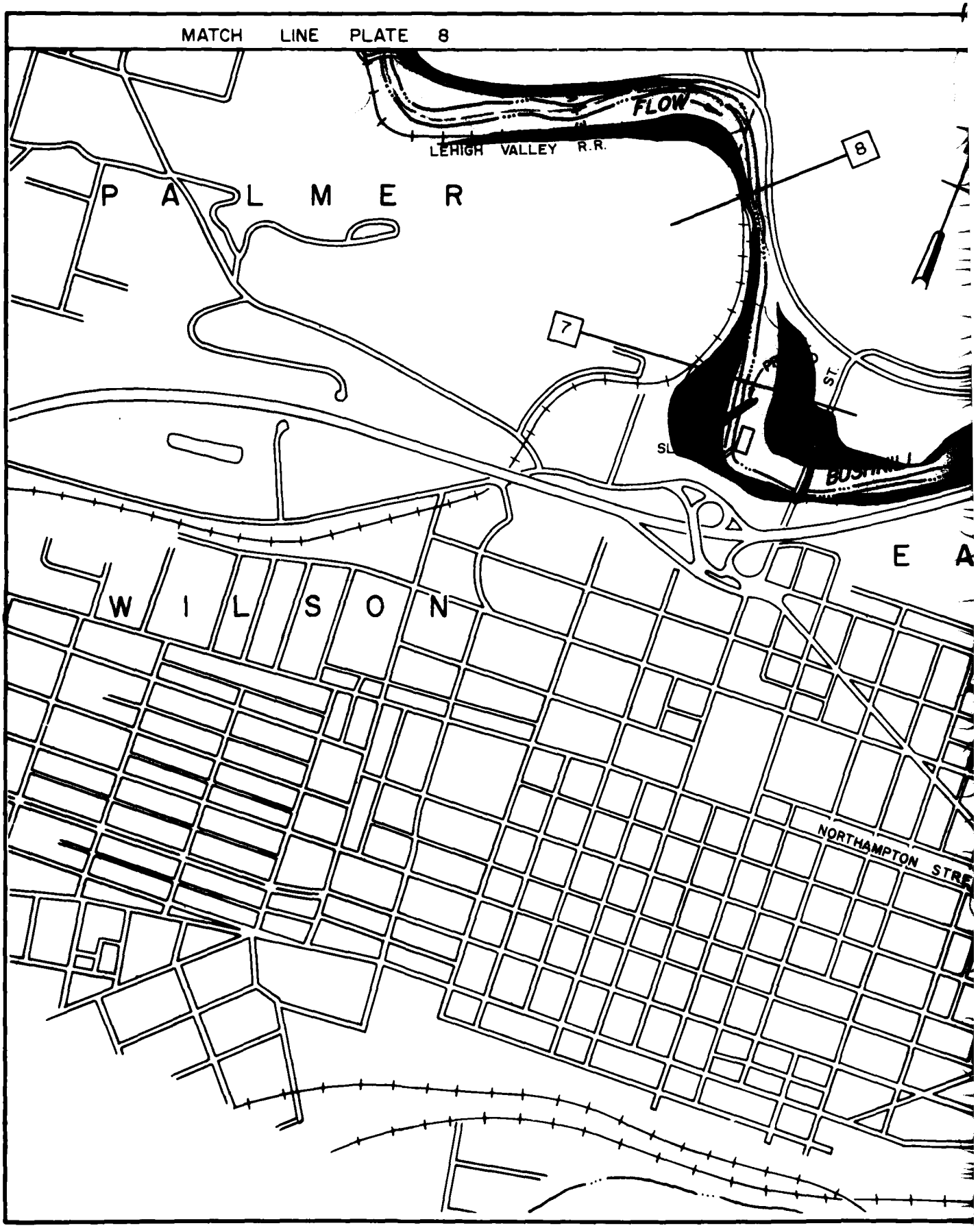
DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

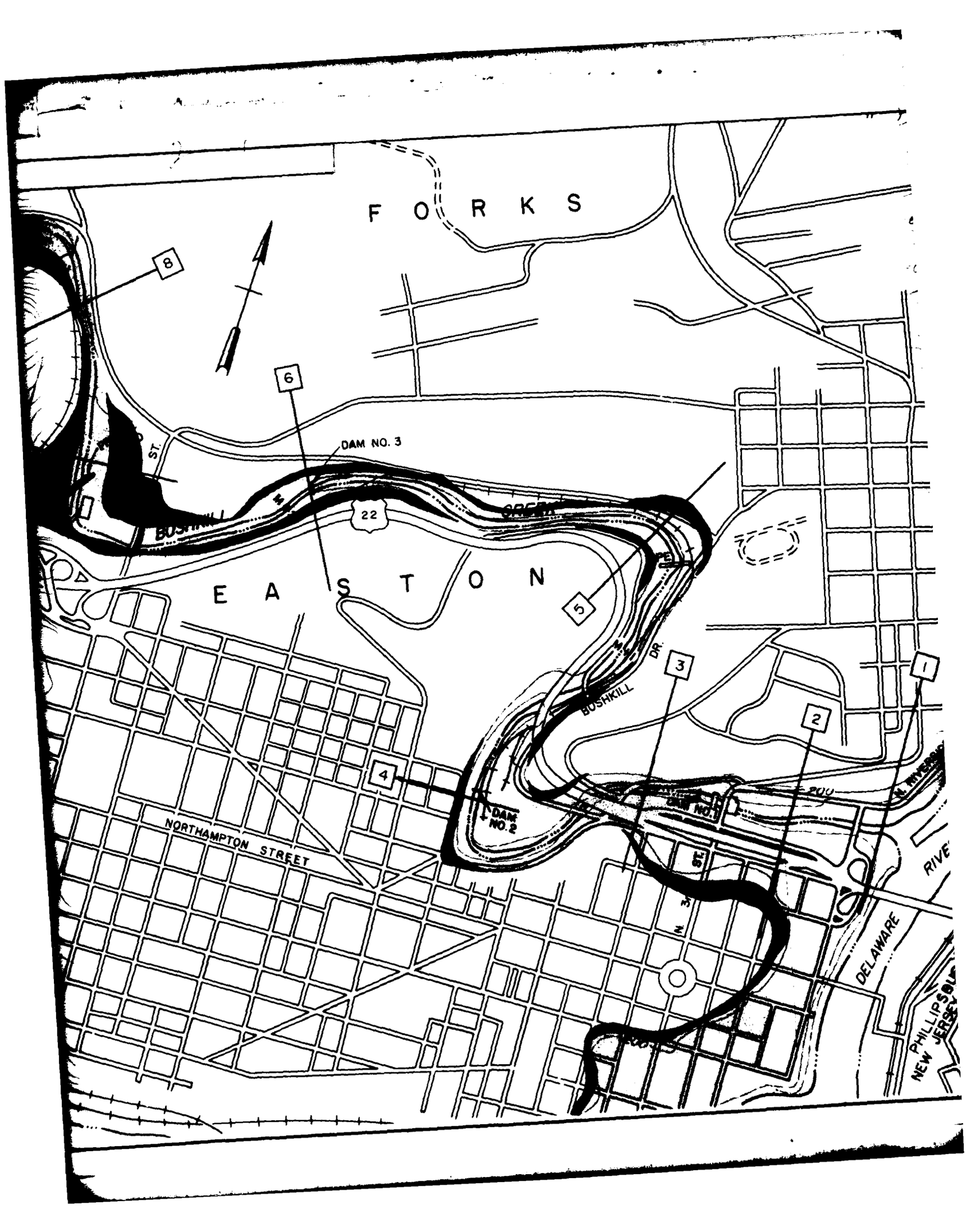
FLOOD PLAIN INFORMATION

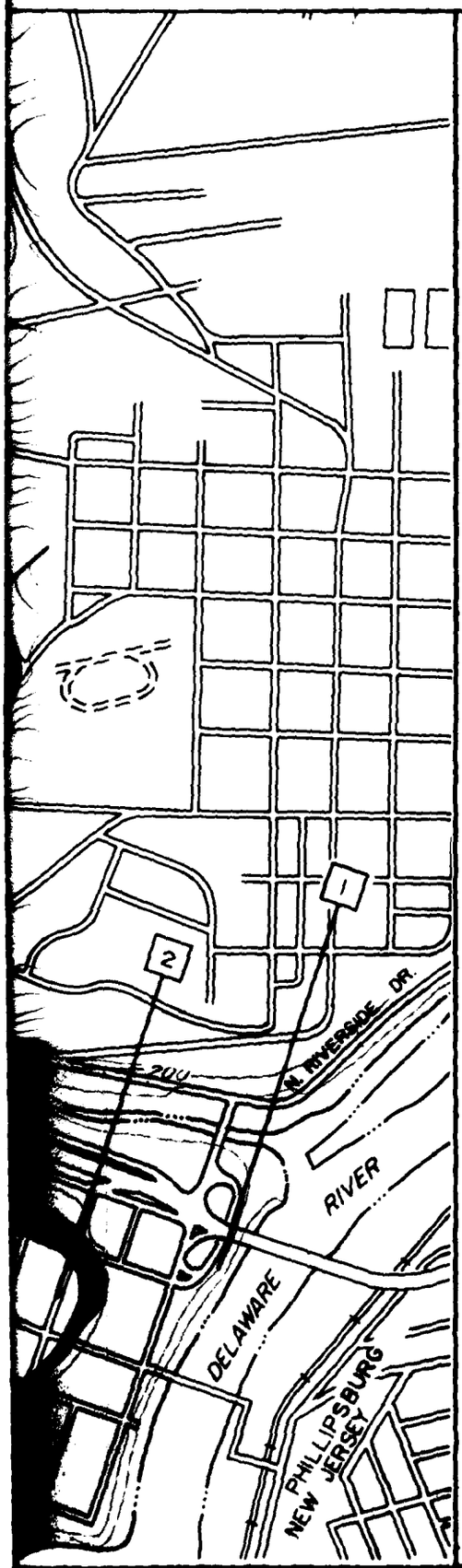
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

FLOODED AREAS
JANUARY 1972

PLATE 8


MATCH LINE PLATE 8
FLOW
LEHIGH VALLEY R.R.
8
P A L M E R
7
ST.
W I L S O N
NORTHAMPTON


FORKS
EASTON
8
6
5
4
3
2
1
22
DAM NO. 3
DAM NO. 2
DAM NO. 1
BUSHKILL
DR.
NORTHAMPTON STREET
DELAWARE
RIVER
N. 3RD ST.
PHILLIPSBURG
NEW JERSEY



LEGEND

OVERFLOW LIMITS

INTERMEDIATE REGIONAL FLOOD		STANDARD PROJECT FLOOD

M+3 MILES ABOVE MOUTH

7 CROSS SECTION

GROUND ELEVATION IN FEET (U.S.C & G.S. 1929 ADJ.) SEA LEVEL DATUM

CHANNEL

CITY OR TOWNSHIP LIMITS

22 U.S. HIGHWAY

NOTES

1. MAP BASED ON U.S.G.S. 7.5 MIN. QUADRANGLE SHEETS EASTON-1956, NAZARETH-1964 & WINDGAP-1960. MINOR ADDITIONS AND ADJUSTMENTS MADE BY CORPS OF ENGINEERS.
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3. AREAS OUTSIDE THE FLOOD PLAIN MAY BE SUBJECT TO FLOODING FROM LOCAL RUNOFF.
4. MINIMUM CONTOUR INTERVAL IS 20 FT.

SCALE IN FEET

0 800 1600

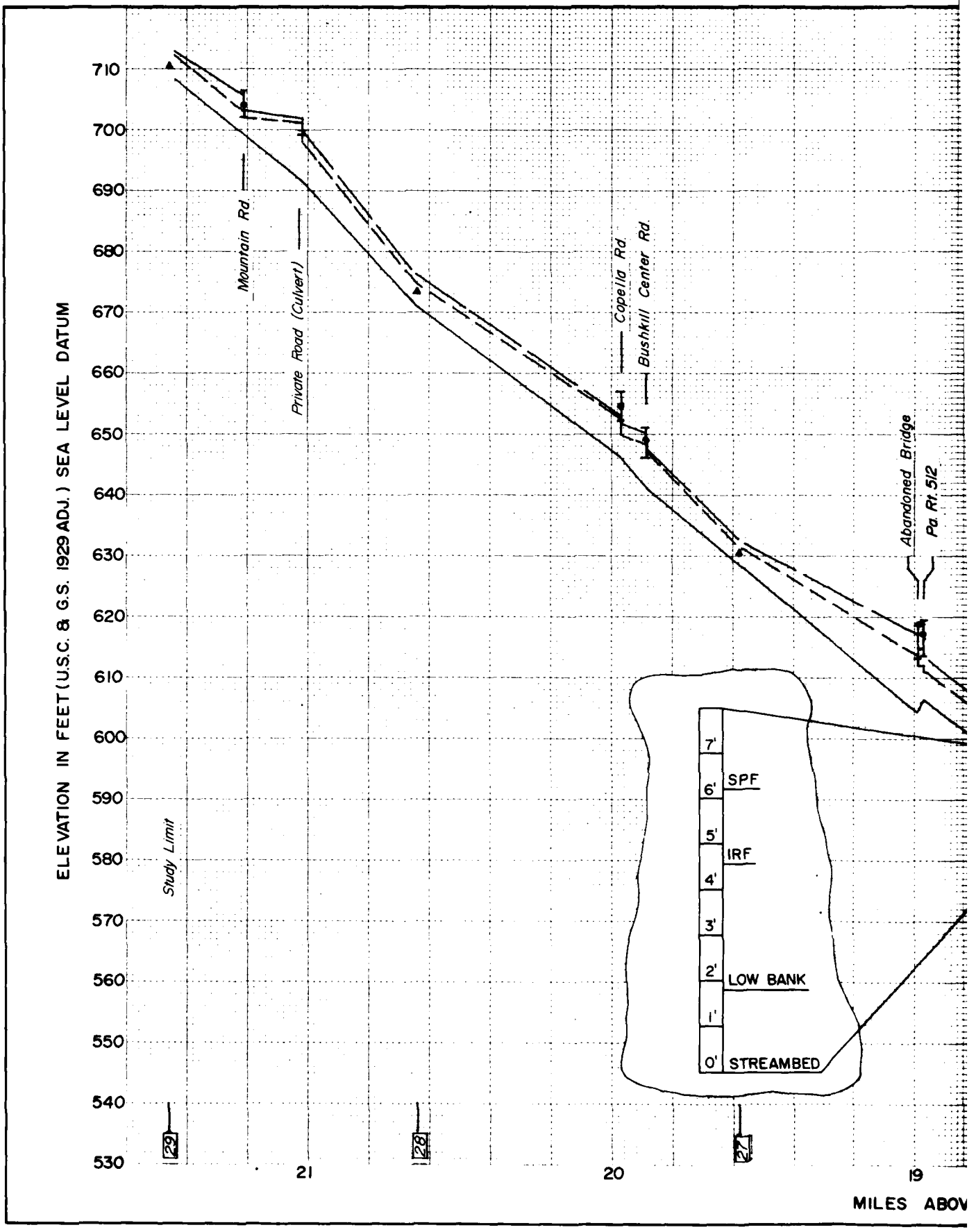
DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

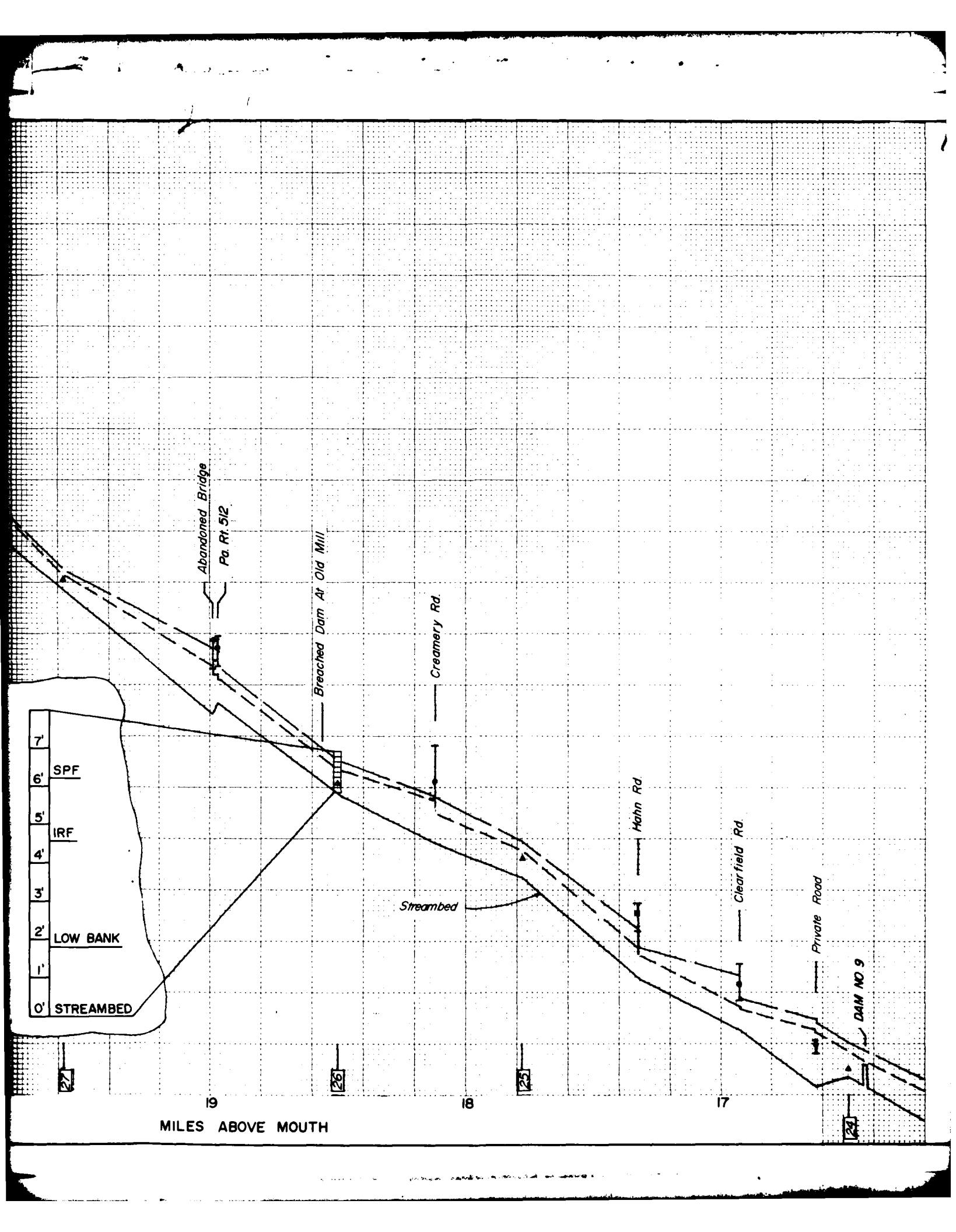
FLOOD PLAIN INFORMATION

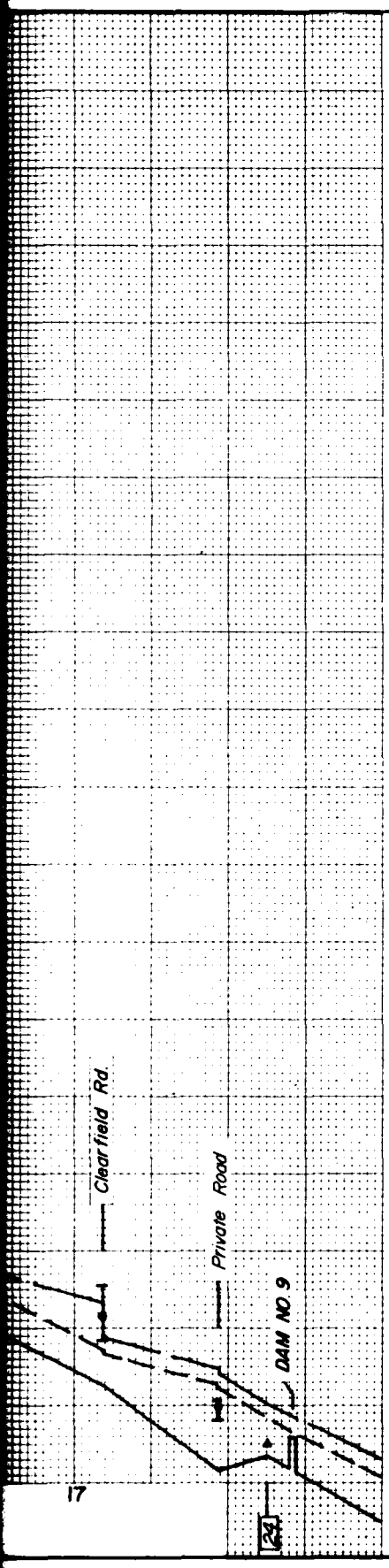
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

FLOODED AREAS
JANUARY 1972

PLATE 9


ELEVATION IN FEET (U.S.C. & G.S. 1929 ADJ.) SEA LEVEL DATUM
710
700
690
680
670
660
650
640
630
620
610
600
590
580
570
560
550
540
530
Study Limit
Mountain Rd.
Private Road (Culvert)
Copelia Rd.
Bushkill Center Rd.
Abandoned Bridge
Pa. Rt. 512
29
28
27
21
20
19
7'
6'
SPF
5'
IRF
4'
3'
2'
LOW BANK
1'
0'
STREAMBED
MILES ABOV


Abandoned Bridge
Pa. Rt. 5I2
Breached Dam At Old Mill
Creamery Rd.
Hahn Rd.
Clearfield Rd.
Private Road
DAM NO 9
Streambed
7'
6'
SPF
5'
IRF
4'
3'
2'
LOW BANK
1'
0'
STREAMBED
27
26
25
24
19
18
17
MILES ABOVE MOUTH



LEGEND

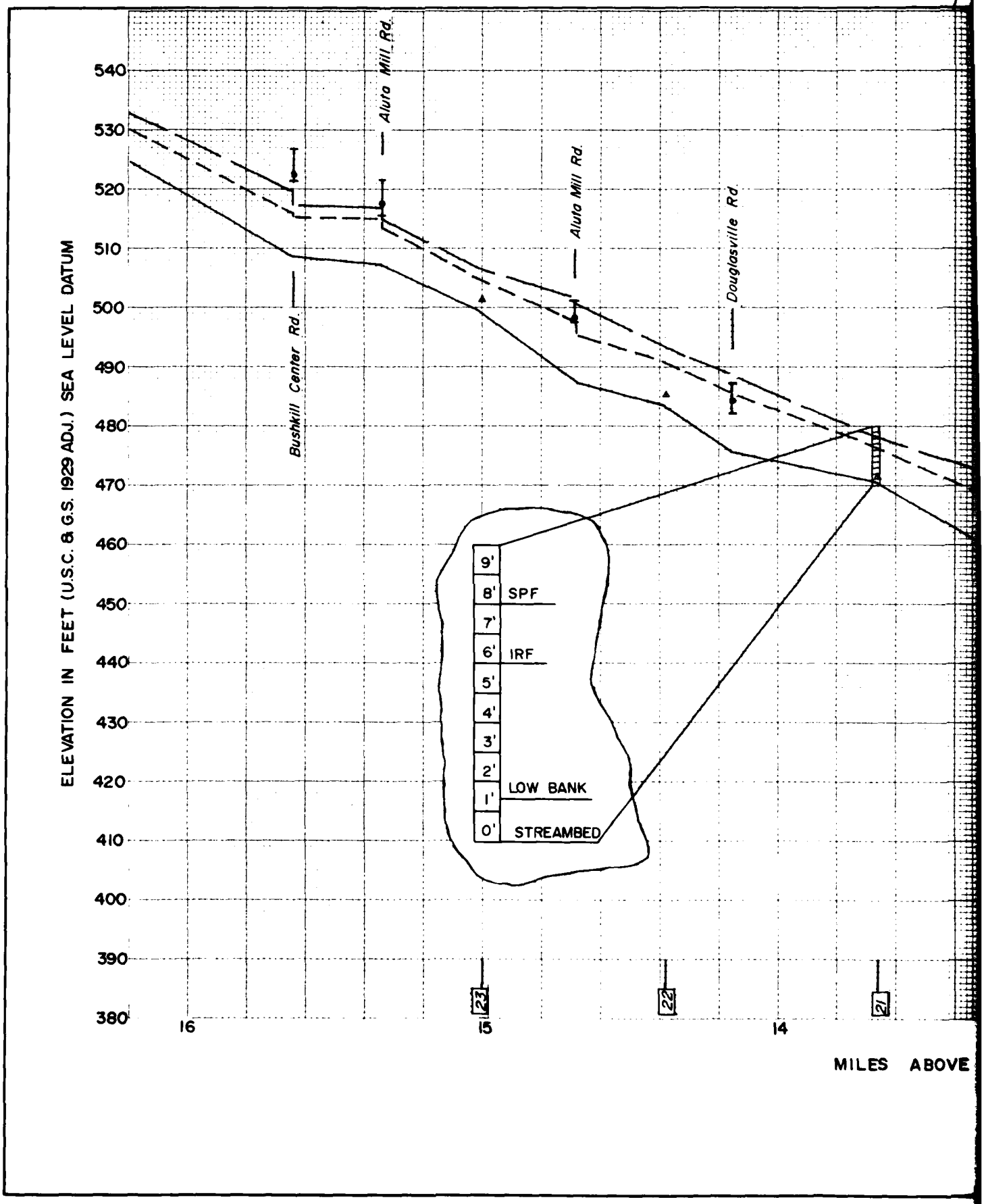
- Top of Bridge Railing
- Underclearance
- Bridge Floor
- Top of Rail (R.R. Bridge)
- Standard Project Flood
- Intermediate Regional Flood
- Low Bank

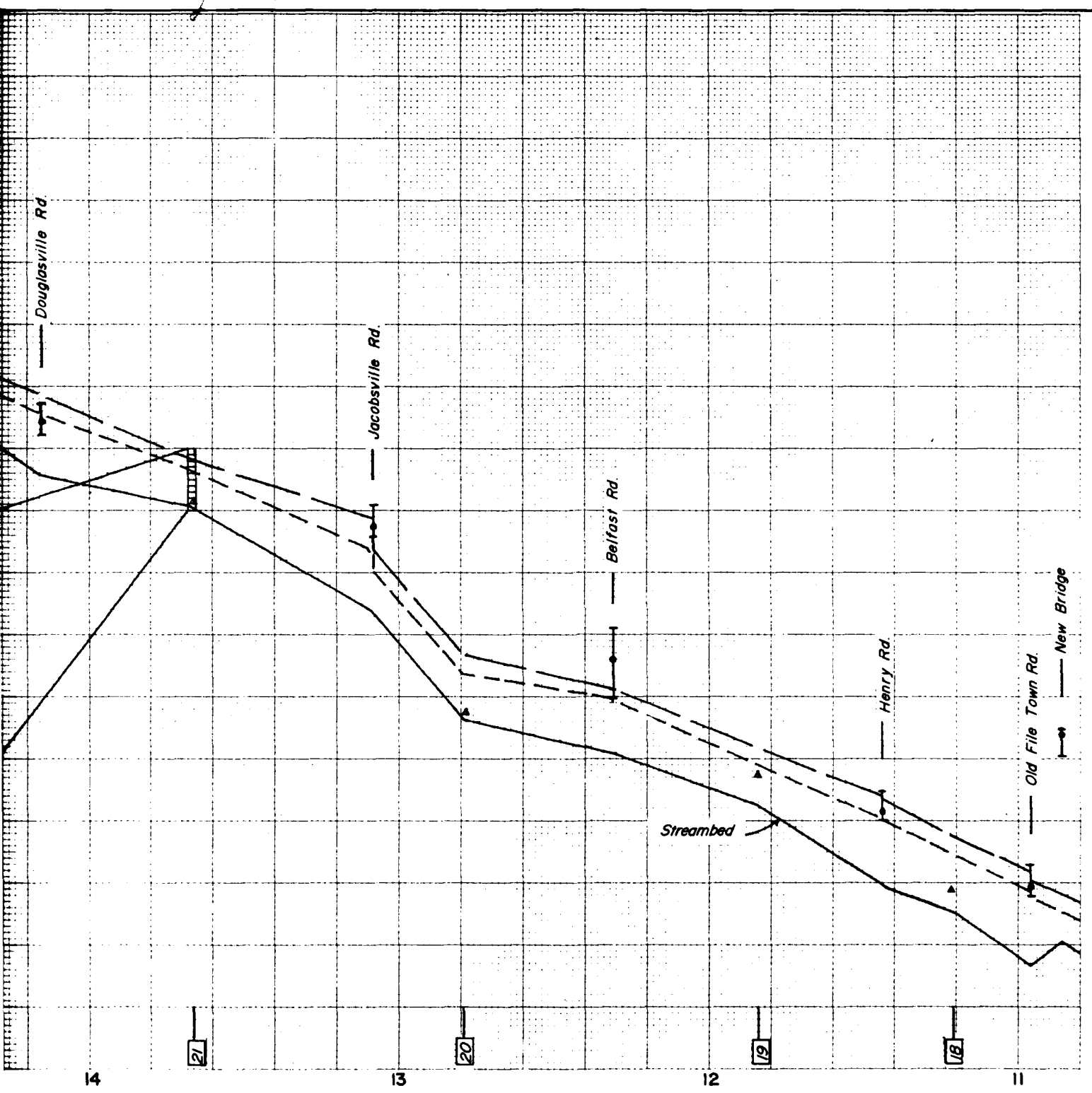
DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

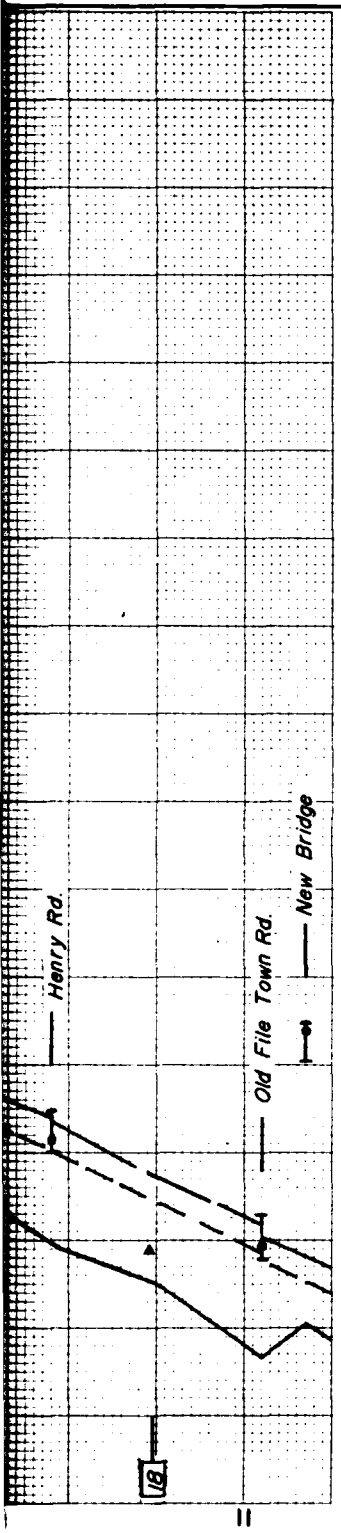
FLOOD PLAIN INFORMATION
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

HIGH WATER PROFILE
JANUARY 1972

PLATE 10


ELEVATION IN FEET (U.S.C. & G.S. 1929 ADJ.) SEA LEVEL DATUM
540
530
520
510
500
490
480
470
460
450
440
430
420
410
400
390
380
Bushkill Center Rd.
Alwa Mill Rd.
Alwa Mill Rd.
Douglasville Rd.
9'
8'
SPF
7'
6'
IRF
5'
4'
3'
2'
1'
LOW BANK
0'
STREAMBED
23
22
21
16
15
14
MILES ABOVE


Douglasville Rd.
Jacobsville Rd.
Belfast Rd.
Henry Rd.
Old File Town Rd.
New Bridge
Streambed
21
20
19
18
14
13
12
11
MILES ABOVE MOUTH



LEGEND

- Top of Bridge Railing
- Underclearance
- Bridge Floor
- Top of Rail (R.R. Bridge)
- ——— Standard Project Flood
- ----- Intermediate Regional Flood
- ▲ Low Bank

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

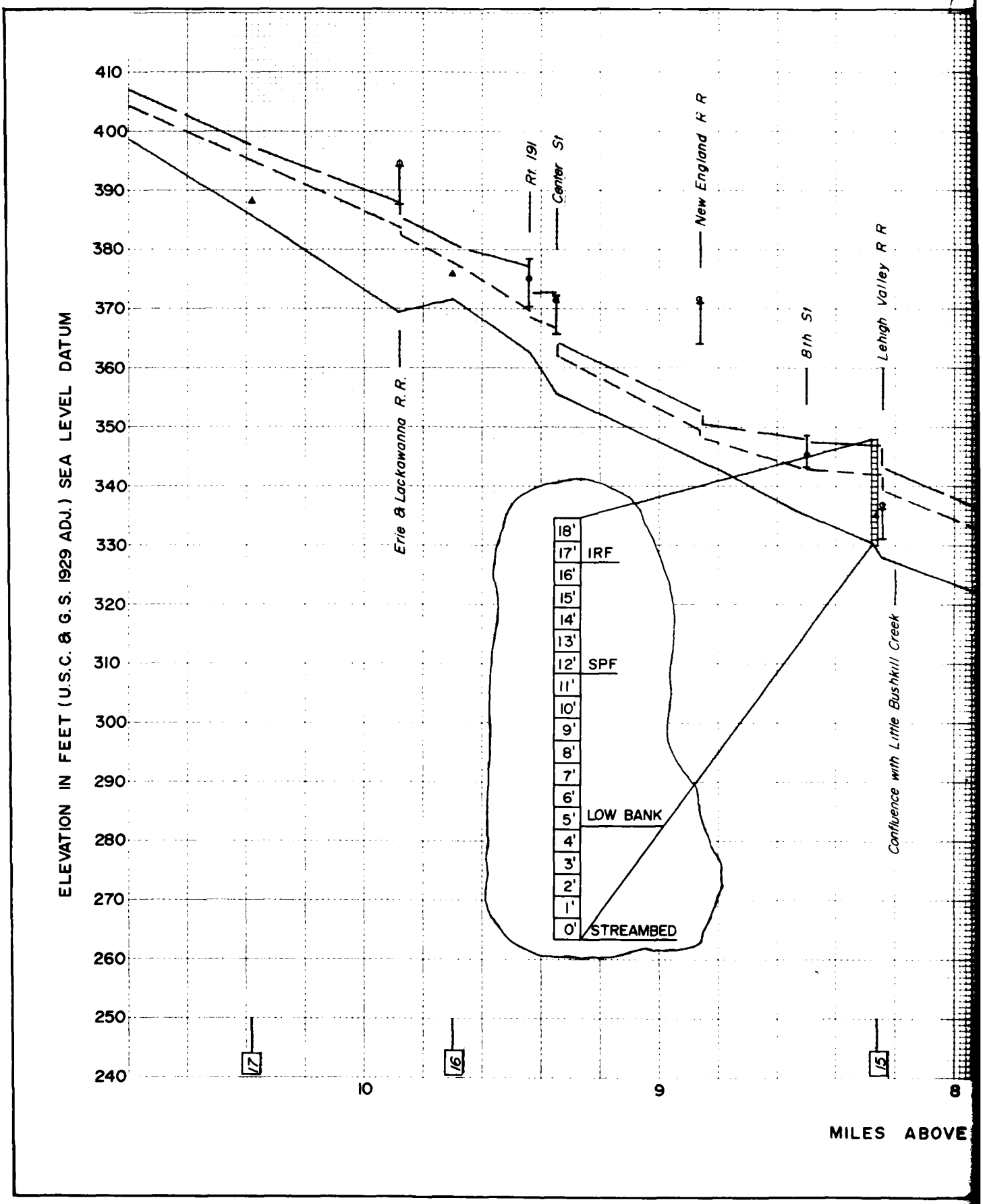
FLOOD PLAIN INFORMATION

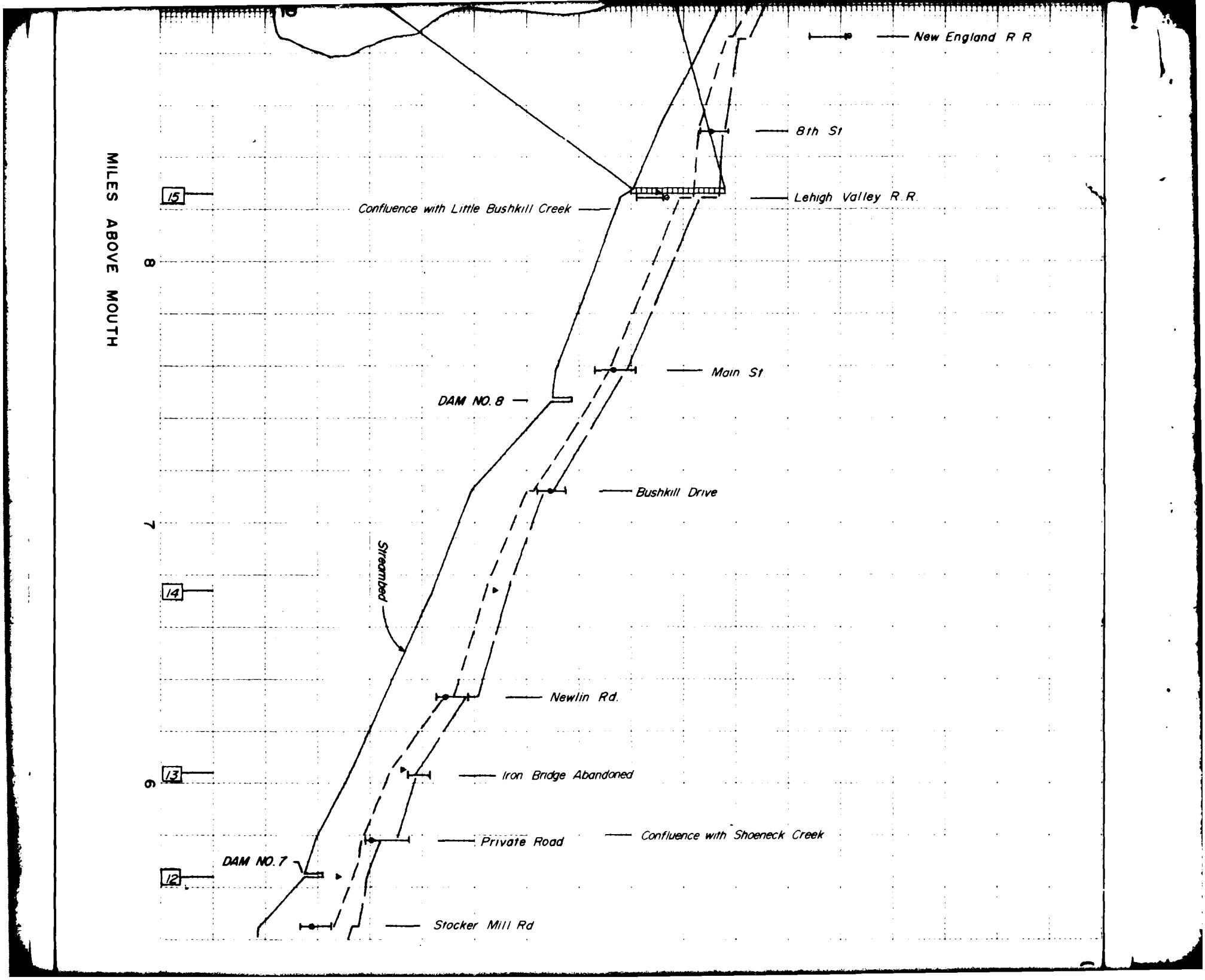
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

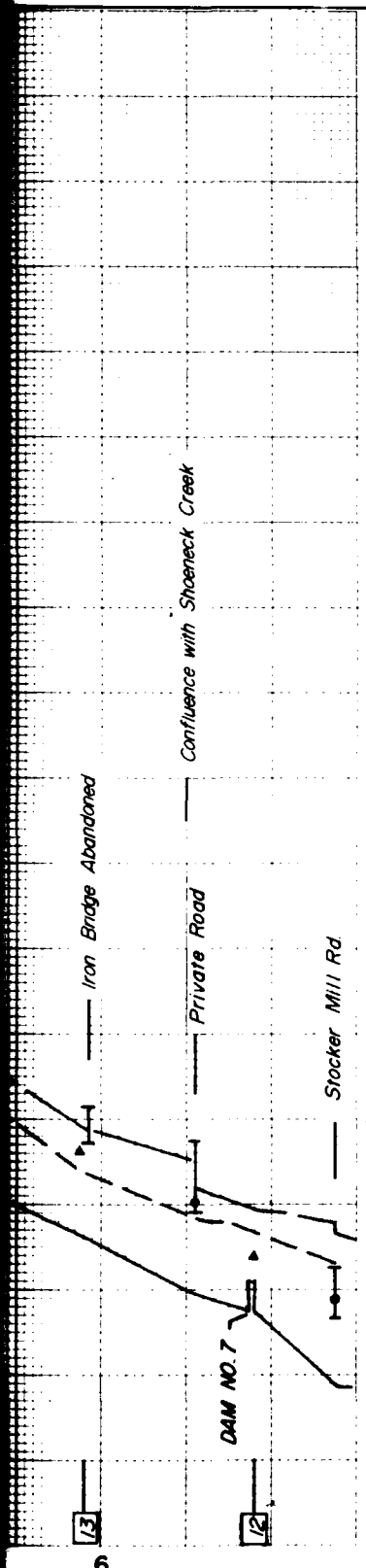
HIGH WATER PROFILE

JANUARY 1972

PLATE 11


ELEVATION IN FEET (U.S.C. & G.S. 1929 ADJ.) SEA LEVEL DATUM
410
400
390
380
370
360
350
340
330
320
310
300
290
280
270
260
250
240
Erie & Lackawanna R.R.
Rt. 191
Center St
New England R R
8th St
Lehigh Valley R R
Confluence with Little Bushkill Creek
18'
17' IRF
16'
15'
14'
13'
12' SPF
11'
10'
9'
8'
7'
6'
5' LOW BANK
4'
3'
2'
1'
0' STREAMBED
17
16
15
10
9
8
MILES ABOVE


MILES ABOVE MOUTH
15
8
7
14
6
13
12
New England R R
8th St
Lehigh Valley R R
Confluence with Little Bushkill Creek
Main St
DAM NO. 8
Bushkill Drive
Streambed
Newlin Rd.
Iron Bridge Abandoned
Private Road
Confluence with Shoeneck Creek
DAM NO. 7
Stocker Mill Rd



6

LEGEND

- Top of Bridge Railing
- Underclearance
- Bridge Floor
- Top of Rail (R.R. Bridge)
- Standard Project Flood
- Intermediate Regional Flood
- Low Bank

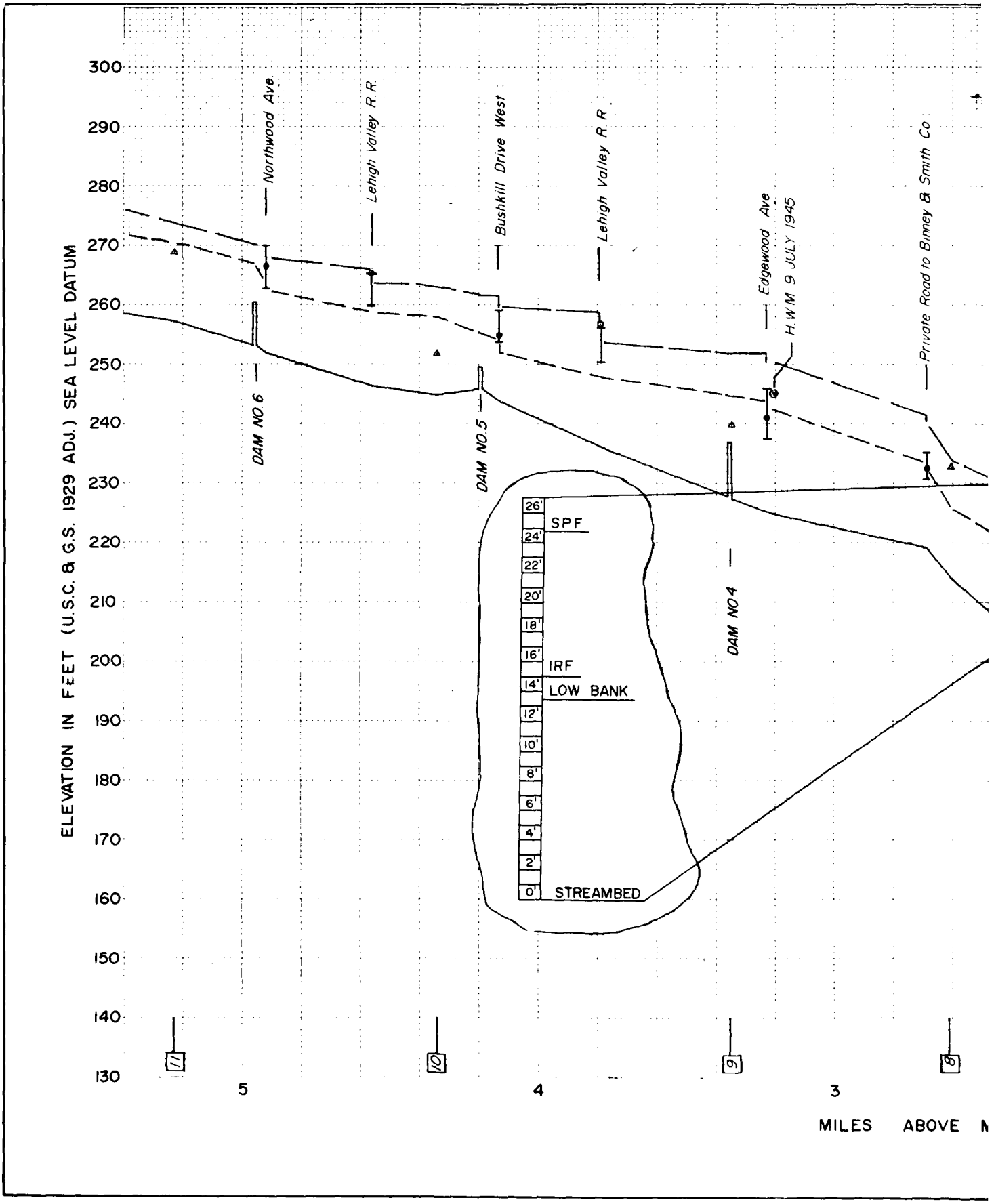
DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA PENNSYLVANIA

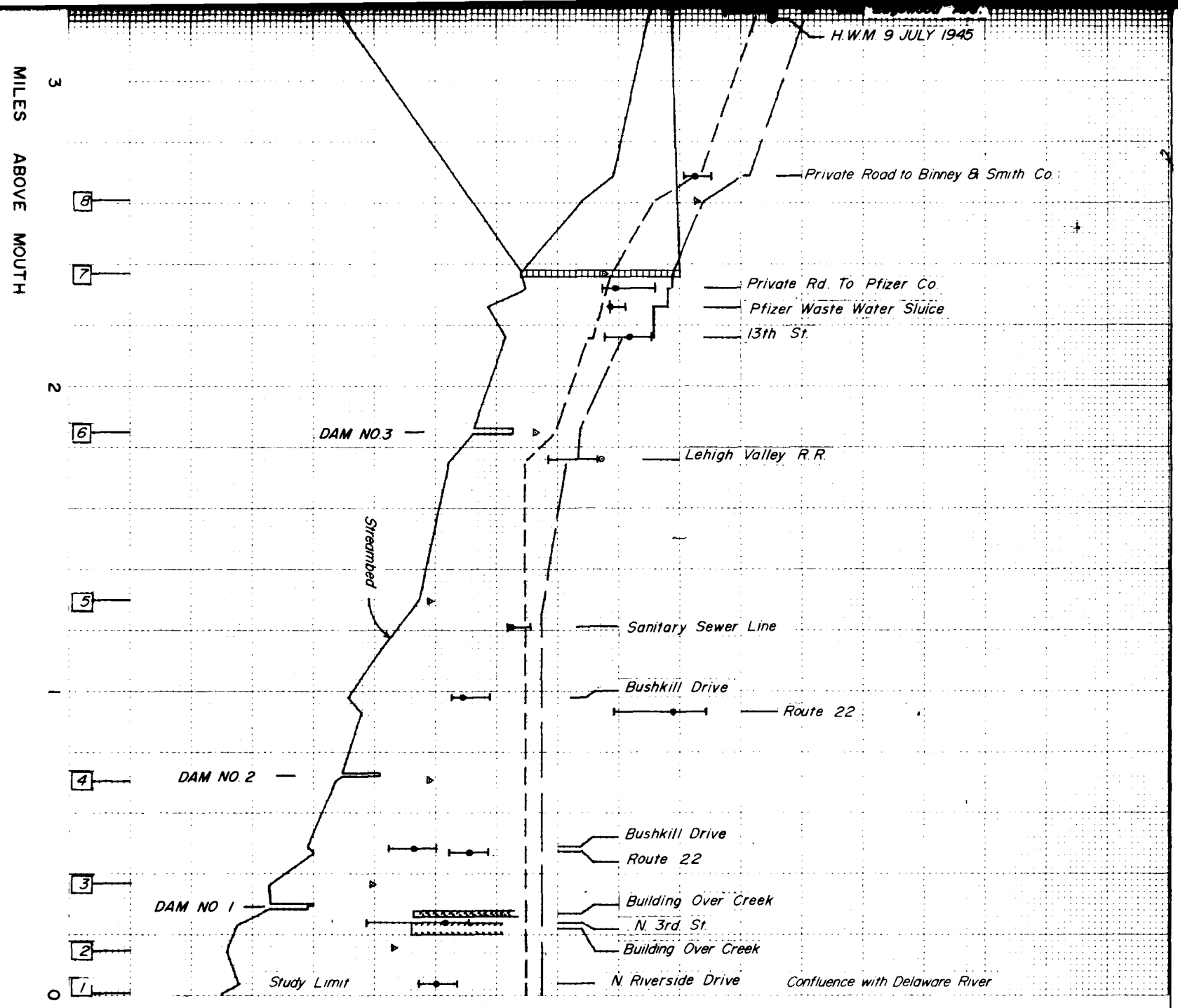
FLOOD PLAIN INFORMATION
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

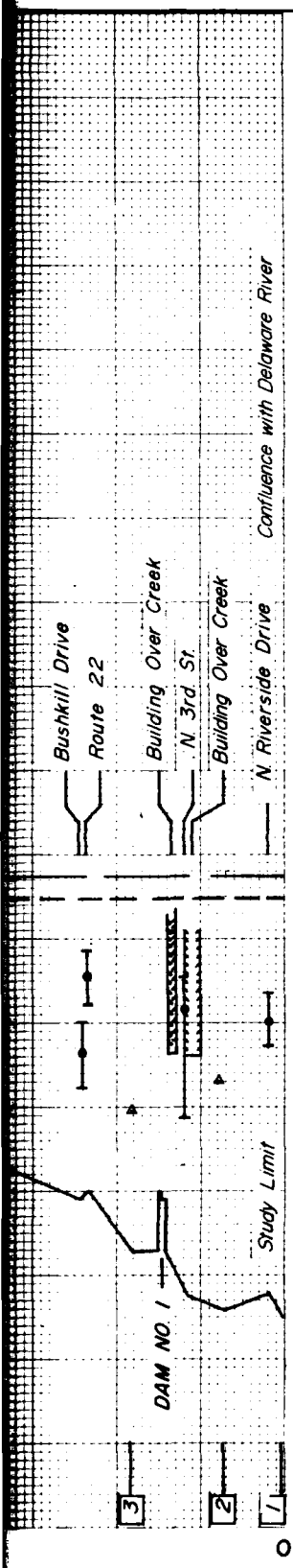
HIGH WATER PROFILE

JANUARY 1972

PLATE 12


ELEVATION IN FEET (U.S.C. & G.S. 1929 ADJ.) SEA LEVEL DATUM
300
290
280
270
260
250
240
230
220
210
200
190
180
170
160
150
140
130
Northwood Ave
Lehigh Valley R.R.
Bushkill Drive West
Lehigh Valley R.R.
Edgewood Ave
H.W.M. 9 JULY 1945
Private Road to Binney & Smith Co
DAM NO.6
DAM NO.5
DAM NO.4
26'
SPF
24'
22'
20'
18'
16'
IRF
14'
LOW BANK
12'
10'
8'
6'
4'
2'
0'
STREAMBED
11
10
9
8
5
4
3
MILES ABOVE M


MILES ABOVE MOUTH
3
2
1
0
8
7
6
5
4
3
2
1
H.W.M. 9 JULY 1945
Private Road to Binney & Smith Co.
Private Rd. To Pfizer Co.
Pfizer Waste Water Sluice
13th St.
DAM NO.3
Lehigh Valley R.R.
Streambed
Sanitary Sewer Line
Bushkill Drive
Route 22
DAM NO. 2
Bushkill Drive
Route 22
DAM NO. 1
Building Over Creek
N. 3rd St.
Building Over Creek
Study Limit
N. Riverside Drive
Confluence with Delaware River



LEGEND

- Top of Bridge Railing
- Underclearance
- Bridge Floor
- Top of Rail (R.R. Bridge)
- Standard Project Flood
- Intermediate Regional Flood
- Low Bank

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

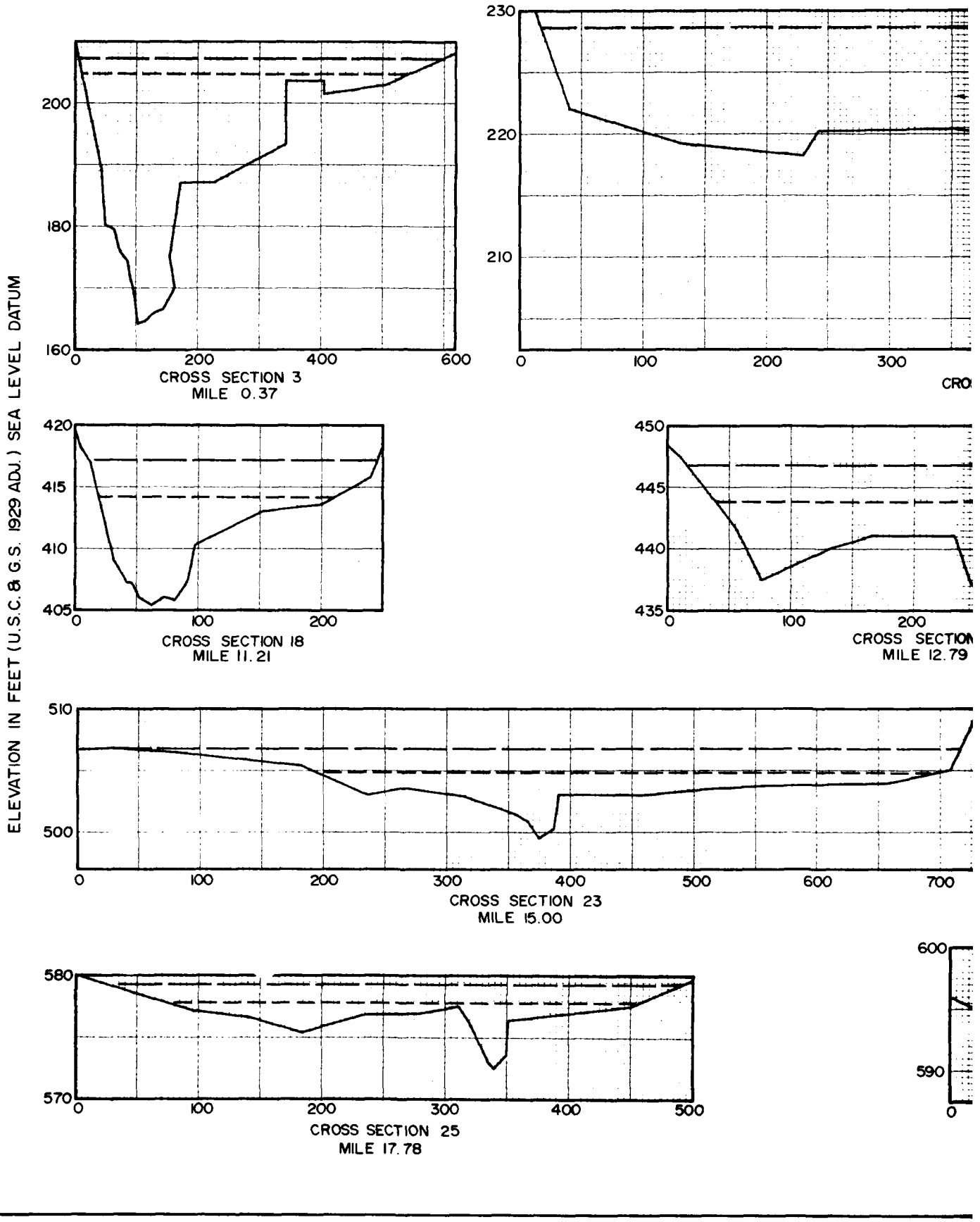
FLOOD PLAIN INFORMATION

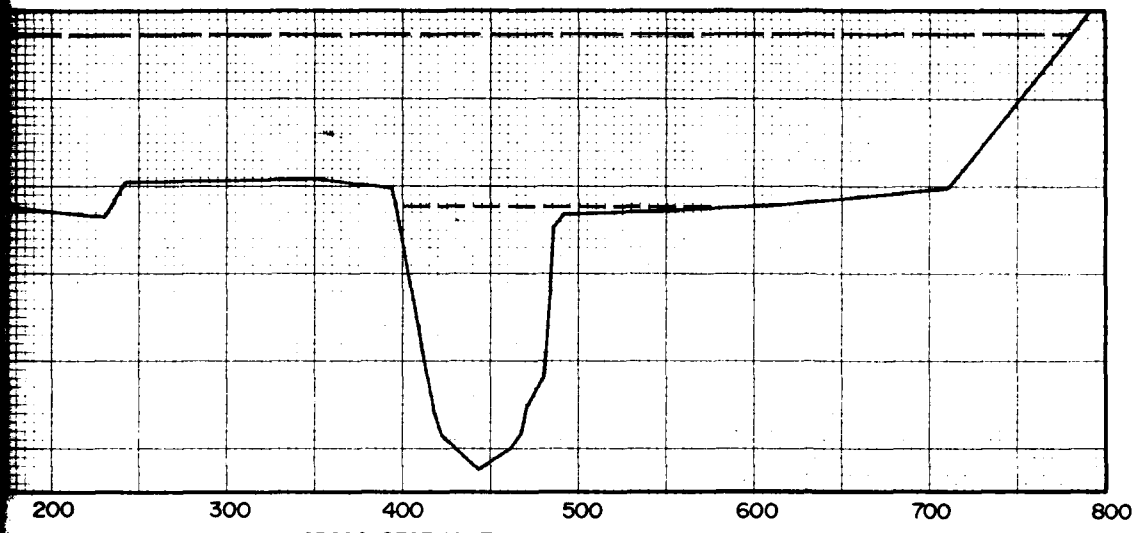
BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

HIGH WATER PROFILE

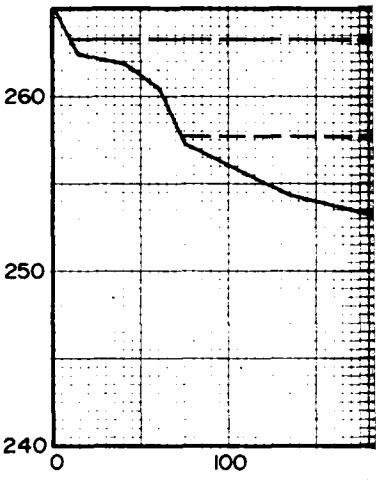
JANUARY 1972

PLATE 13

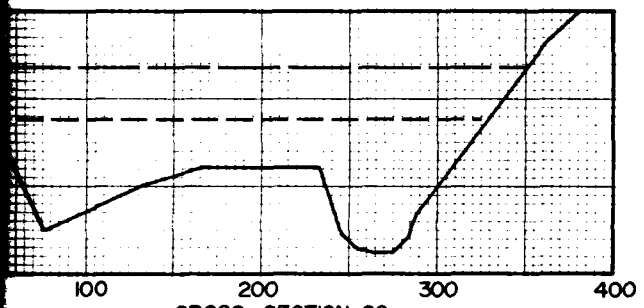

ELEVATION IN FEET (U.S.C.& G.S. 1929 ADJ.) SEA LEVEL DATUM
200
180
160
0
200
400
600
CROSS SECTION 3
MILE 0.37
230
220
210
0
100
200
300
CRO
420
415
410
405
0
100
200
CROSS SECTION 18
MILE 11.21
450
445
440
435
0
100
200
CROSS SECTION
MILE 12.79
510
500
0
100
200
300
400
500
600
700
CROSS SECTION 23
MILE 15.00
580
570
0
100
200
300
400
500
CROSS SECTION 25
MILE 17.78
600
590
0



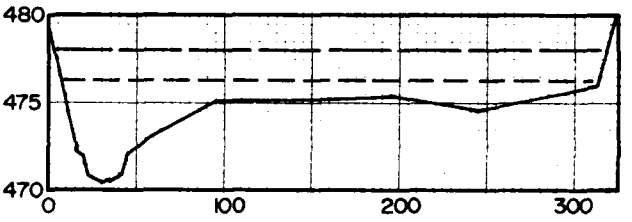
CROSS SECTION 7
MILE 2.37



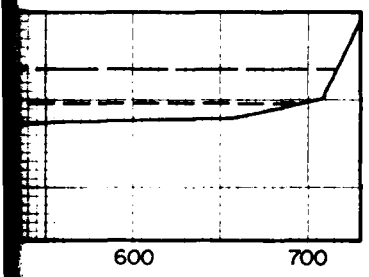
CROS
M

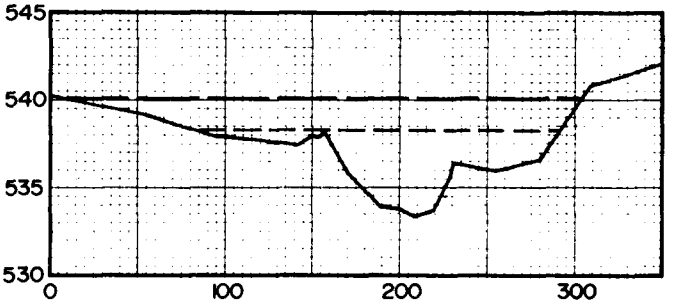


CROSS SECTION 20
MILE 12.79

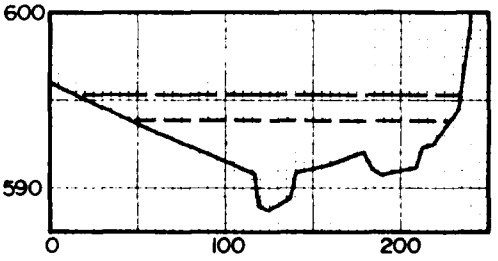


CROSS SECTION 21
MILE 13.66

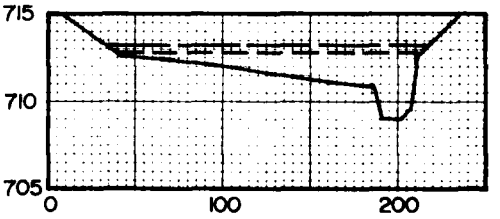




CROSS SECTION 24
MILE 16.50

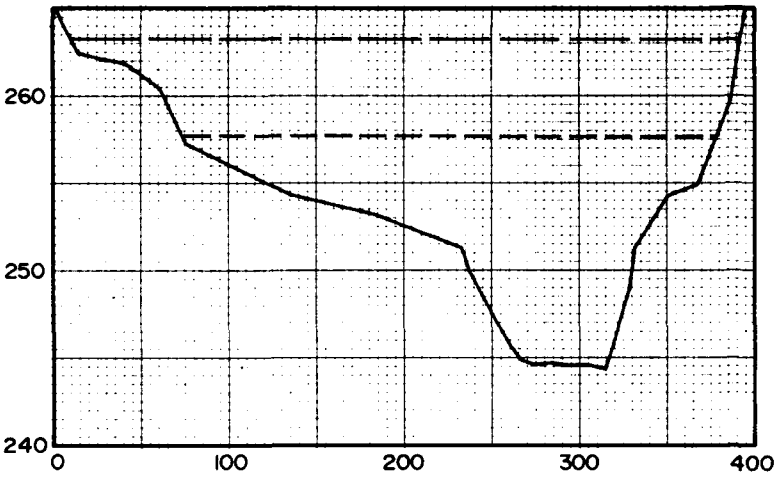


CROSS SECTION 26
MILE 18.50

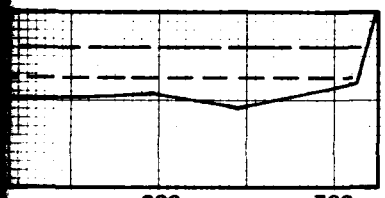


CROSS SECTION 29
MILE 21.46

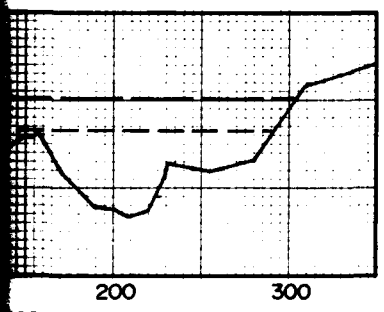
HORIZONTAL DISTANCE IN HUNDREDS OF FEET



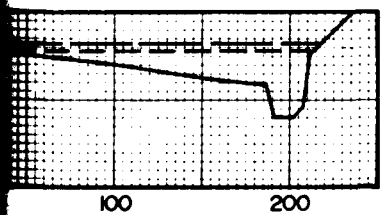
CROSS SECTION 10
MILE 4.34



CROSS SECTION 21
MILE 13.66



OSS SECTION 24
MILE 16.50



CROSS SECTION 29
MILE 21.46

LEGEND

——— ——— Standard Project Flood

— — — — Intermediate Regional Flood

——————— Ground Line

Sections taken looking downstream

18 Sections not shown

DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

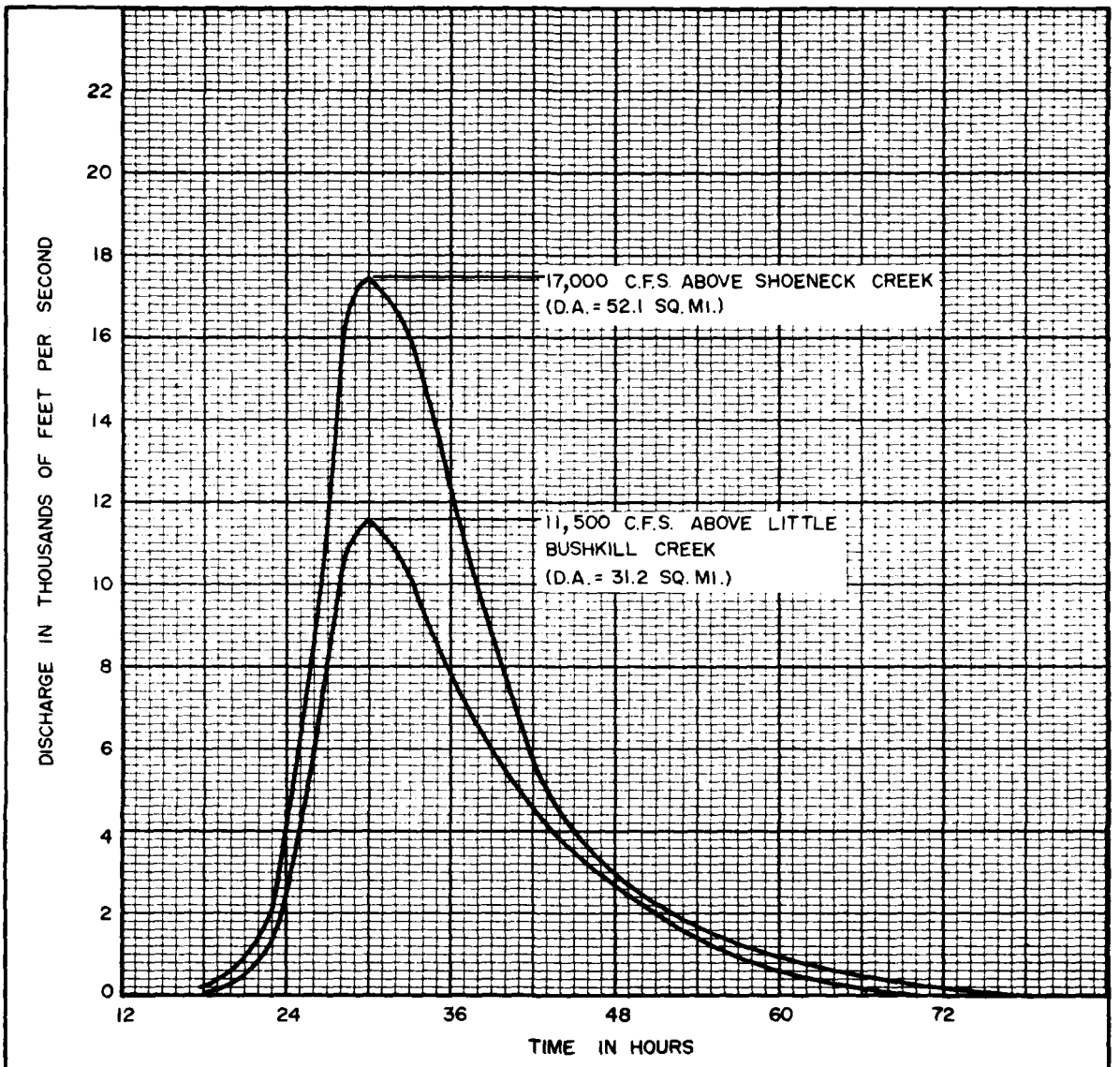
FLOOD PLAIN INFORMATION

BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

SELECTED CROSS SECTIONS

JANUARY 1972

PLATE 14



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT CORPS OF ENGINEERS
PHILADELPHIA, PENNSYLVANIA

FLOOD PLAIN INFORMATION

BUSHKILL CREEK
NORTHAMPTON COUNTY, PENNSYLVANIA

STANDARD PROJECT FLOOD
HYDROGRAPH

PLATE 15


ATE
LME